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General Specifications—Appendix 4

Specifications for Riveting

and

Reference Data for Use Therewith

Bureau of Construction and Repair
Navy Department

EDITION OF 1919



WASHINGTON
GOVERNMENT PRINTING OFFICE
1919



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FEBRUARY, 1919.

The following specifications for riveting are to be considered as standard for work under cognizance of the Bureau of Construction and Repair and will supersede "Instructions for Riveting Naval Vessels," edition of 1914.

The modifications introduced will be followed only for work contracted for after the issuing of these specifications, unless the contractors desire to do so for vessels contracted for previous to that date as a development of the plans and specifications.

D. W. TAYLOR,

Rear Admiral, Chief Constructor, U. S. Navy.

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CONTENTS.

SPECIFICATIONS.

GENERAL:

	Par.	Page.
Material of rivets.....	1	7
Rivets for different classes of steel material.....	2	7
Exceptions to the requirements.....	3	7
Rivet schedules.....	4	7
Where special approval is required.....	5	8

WORKMANSHIP:

Hammer marks.....	6	8
Use of calking pieces.....	7	8

PUNCHING, REAMING, DRILLING, TAPPING, AND COUNTER-SINKING:

Punching.....	8	8
Unfair holes.....	9	8
Rejection of material.....	10	8
Holes punched small and reamed.....	11	8
Holes drilled, or punched small and reamed.....	12	9
Reaming.....	13	9
Holes in high tensile steel.....	14	9
Holes for tap rivets.....	15	9
Countersinking, general.....	16	10
Countersinking, special.....	17	10

TREATMENT OF FAYING SURFACES.....

	18	10
--	----	----

STOPWATERS AND OIL STOPS:

Stopwaters, use of.....	19	11
Material of stopwaters.....	20	11
Oil stops, use of.....	21	11
Material of oil stops.....	22	11
Alternative materials, stopwaters.....	23	11
Use of materials other than specified.....	24	11
Materials to be fresh when used.....	25	11

BOLTING AND RIVETING:		
Bolting up.....	26	12
Condition of work.....	27	12
Suitability of rivets.....	28	12
Heating of rivets.....	29	12
Use of power in riveting.....	30	12
Rivet points.....	31	12
Rivets driven cold.....	32	12
Testing of rivets.....	33	12
TYPES OF RIVETS—TABLE.....	34	12
SIZES OF RIVETS—TABLE.....	35	15
Vessels of special light construction.....	36	16
Connection of different thicknesses.....	37	16
Rivets in stems and sternposts.....	38	16
Three and four ply riveting.....	39	16
Double-strapped butts.....	40	16
Tap rivets.....	41	16
BUTT CONNECTIONS; ROWS OF RIVETING FOR:		
Single butt straps, butt laps, and double butt straps— table.....	42	17
Double butt straps, "special"—table.....	43	18
ARRANGEMENT OF RIVETS IN ROWS:		
In plates.....	44	18
In shapes.....	45	18
DISTANCES BETWEEN ROWS OF RIVETS, AND TO EDGES OF PLATES AND SHAPES:		
Distances between rows, seams, and single straps.....	46	18
Distances between rows, butt laps, and double straps..	47	18
Distances between rows for zigzag riveting.....	48	18
Distances of rivets from edges.....	49	19
Distances of taps from edges.....	50	19
PLATE LAPS AND BUTT AND SEAM STRAPS:		
Widths of laps and straps.....	51	19
Thickness of single butt and seam straps.....	52	19
Thickness of double butt straps.....	53	20
Thickness of straps increased if rivet holes are counter- sunk.....	54	20
Where plates strapped are of different thicknesses.....	55	20

SPACING OF RIVETS IN ROWS:

	Par.	Page.
TABLE, GENERAL.....	56	20
Seam laps and seam straps.....		20
Single butt straps and butt laps.....		21
Double butt straps.....		22
Double butt straps, "special".....		23
Angles to plates, including staples.....		23

TABLE OF ADDITIONS AND EXCEPTIONS TO GENERAL

TABLE.....	57	24
Vertical keel where non-watertight.....		24
Longitudinals, where non-watertight.....		24
Transverse framing where non-watertight.....		25
Decks and platforms.....		25
Bulkheads.....		26
Seatings.....		26
In way of armor.....		27
Turrets, and foundations for turrets and guns.....		27
Miscellaneous and general.....		28
Modifications of spacing.....	58	29

CALCULATED JOINTS.....	59	29
Basis for strength.....	60	29
Tensile strength of medium steel.....	61	29
Tensile strength, high tensile steel.....	62	29
Joints in special-treatment steel.....	63	29
Shearing strength, single shear.....	64	29
Shearing strength, double shear.....	65	29
Area of rivet for shear.....	66	30
Bearing value.....	67	30

EFFICIENCIES OF JOINTS.....	68	30
Laps and single straps, all rivet rows complete—table..		31
Single straps, alternate rivets in the outer row omitted and with wide spacing in the outer row—table.....		32
Double straps, all rivet rows complete—table.....		33
Double straps, alternate rivets omitted and with wide spacing in the outer row—table.....		34
Double straps, "special"—table.....		35

CURVES OF EXACT SPACING OF RIVETS FOR JOINTS OF MAXI- MUM STRENGTH.....	69	36
SINGLE STRAPS.....	Plate 1	
DOUBLE STRAPS.....	Plate 2	

	Par.	Page.
STANDARD RIVETS.....	70	37
Pan heads.....	Illust.	37
Button heads.....	Illust.	38
Countersunk heads, flat.....	Illust.	39
Countersunk heads, raised.....	Illust.	40
Taps.....	Illust.	41
Rivet points.....	Illust.	42
SYMBOLS FOR RIVETS AND RIVETING.....	71	43

REFERENCE DATA.

WIDTHS OF LAPS AND STRAPS:		
Chain riveting—table.....	72	46
Zigzag riveting—table.....	73	48
WIDTHS OF DOUBLE BUTT STRAPS:		
Chain riveting—table.....	74	50
GAGE TABLE FOR SHAPES:		
Single riveting.....	75	51
Double riveting.....	76	52
LENGTHS OF RIVETS FOR ORDERING:		
Allowances for Points—table.....	77	53
WEIGHTS OF RIVETS—TABLE.....	78	54
REDUCTION OF DIAMETERS TO INCHES—TABLE.....	79	56
SPACING TABLES.....		58

GENERAL SPECIFICATIONS—APPENDIX 4.

SPECIFICATION FOR RIVETING.

EDITION OF 1919.

GENERAL.

1. Rivets for all structural work shall be of steel, unless ^{Material of rivets.} otherwise specified, and shall conform to and pass the tests prescribed by the specifications for “**Steel Hull Rivets and Rivet Rods**” issued by the Navy Department. (Obtainable from Bureau of Supplies and Accounts.)

2. Unless otherwise specified or approved, rivets connecting medium steel parts shall be of medium steel, rivets ^{Rivets for different classes of steel material.} connecting high tensile steel parts shall be of high tensile steel, and rivets connecting high tensile and medium steel parts, where strength is of special consideration, shall be of high tensile steel. Where high tensile steel plating is connected to medium steel frames and beams, etc., and in other connections of these materials where strength is not of special consideration, medium steel rivets may be used if desired. Rivets for special treatment steel and nickel steel shall be as indicated on the contract plans, or as specified in the vessel's detail specifications. In general it is contemplated to unite these members among themselves and with each other by high tensile rivets for strength and ballistic purposes.

3. Where conditions occur such as are not definitely ^{Exceptions to the requirements.} covered by the requirements herein, the riveting, together with the width of laps, straps, and flanges of angle bars, etc., used in connection therewith, shall be subject to approval.

4. Structural working drawings shall specify the material of rivets, the types of heads and points, and the sizes ^{Rivet schedules.} and spacings of rivets to be used.

Where special
approval is re-
quired.

5. Where special approval is required herein it is intended that the matters involved shall, in general, be passed upon direct by the Superintending Constructor or by the Construction Officer.

WORKMANSHIP.

Hammer marks.

6. Plates, angles, etc., shall not be marred nor show an undue amount of hammer marks around rivet holes.

Use of calking
pieces.

7. Butts and edges of plates and butts of angles in strapped joints shall fit closely together after being riveted. Calking pieces shall not be inserted in any such joints in water-tight or oil-tight work, unless specifically authorized.

PUNCHING, REAMING, DRILLING, TAPPING, AND COUNTERSINKING.

Punching.

8. Punches and dies shall be kept in an efficient condition, and shall fit in the punching machines so as to punch holes fair and normal to the surface. Holes shall, in general, be punched from the side which will form the faying surface; where this is not done they shall be punched small, and reamed, as necessary to obtain a smooth surface before the material is put in place. Burring of any kind between faying surfaces shall be avoided.

Unfair holes.

9. Care shall be taken in punching and drilling to prevent unfair holes. Where such occur they shall be reamed out before riveting, and rivets suitable for the increased sizes of holes used. No drifting to overcome unfair holes will be allowed.

Rejection of ma-
terial.

10. Where the number or the diameter of individual holes reamed out to an increased size for the purpose of removing unfairness is such as will impair the strength of the structure, the material involved shall be rejected unless satisfactory compensation is fitted.

Holes punched
small and
reamed.

11. Rivet holes shall be punched small and reamed—
(a) in work subject to test requirements for oil tightness,

(b) in work where strength is of special importance, (c) in three or more thicknesses of material.

12. Rivet holes through material of thickness corresponding to a nominal weight of **40 pounds** or more per square foot shall be either drilled or punched small and reamed to the designed size. Holes drilled, or punched small and reamed.

13. For holes required to be "**punched-small-and-reamed**" to the designed size, see table, paragraph 35. Reaming.

14. All rivet holes through high tensile steel shall be drilled, except where material is **12 pounds** and less, nominal weight, the holes may be punched small and reamed. Holes in high tensile steel.

15. Drilling and tapping of holes for tap rivets must be done in such manner as to insure a first-class fit of the threads and to permit of the rivets being set up tight. The minimum penetration of the threaded part should be **1 diameter**. They should penetrate **1 1/2 diameters** when practicable. Holes for tap rivets.

The diameter of drills for tap rivets shall be in accordance with the following table:

Diameter in inches.		Number of threads per inch, United States standard.
Tap rivet.	Tap drill.	
3/8	5/16	16
1/2	27/64	13
5/8	33/64	11
3/4	41/64	10
7/8	3/4	9
1	55/64	8
1-1/8	61/64	7
1-1/4	1-3/32	7

Countersinking, general. 16. The angles of countersinks shall be as given on pages 39-41 for heads of rivets. In plates and shapes of thickness corresponding to a nominal weight of 12 1/2 pounds and less, the depth of countersink may be the full thickness of the material; in plates and shapes of greater thickness the depth of countersink shall be approximately 1/16 inch less than the thickness of the material. Where countersinking in accordance with the above is not suitable for one of the standard heads of rivets, of the required diameter, as shown on pages 39-41, it shall be made to suit the nearest standard depth of rivet head. But in no case shall the depth of countersink be such that the head of rivet before driving is less than approximately 1/16 inch above the surface of the plate or shape. The head must not be below the surface of the plate or shape after driving.

Countersinking special. 17. Where rivets of the raised countersunk type are to be used the angle of countersink for the holes may, if desired, be increased 3° over the standard angle given on page 40 for head of rivet.

TREATMENT OF FAYING SURFACES.

18. Faying surfaces of all plates and shapes shall be carefully cleaned just before work is assembled. Faying surfaces shall be painted as specified below:

(a) Faying surfaces of non-watertight work shall be painted, except in drinking water, fuel oil and lubricating oil tanks.

(b) Faying surfaces in way of riveting spaced watertight or closer need not be painted at the option of builder.

(c) Faying surfaces of members in contact with drinking water shall not be painted.

The materials for painting faying surfaces must be fresh and must be applied to clean surfaces shortly before the members are assembled. In way of oil compartments, where used, they shall be a mixture of pine tar and shellac, or other approved materials; elsewhere red lead paint shall be used.

STOP WATERS AND OIL STOPS.

19. Stop waters shall not be used to make good defective workmanship or materials nor where the best practice requires metal-to-metal contact. They shall be used, in general, only where non-watertight members pass through watertight members, for the purpose of preventing leakage from one side to the other of the watertight member, as required by **paragraph 32** herein. The materials of stop waters and oil stops must not prevent properly drawing of the members close together for tight riveting and effective calking.

20. Stop waters shall be lampwicking or canvas saturated with a mixture of red and white lead, or lampwicking or canvas soaked in boiled linseed oil and then in red lead paint.

21. In way of oil-tight work, where the material is over the nominal weight of **7 1/2 pounds**, oil stops shall be used only under the general conditions specified above in regard to the use of stop waters, or where metal-to-metal calking is not practicable. Where the material is **7 1/2 pounds**, nominal weight, or less, oil stops may be used in seams, laps, stapling, etc., where necessary to secure oil tightness.

22. Oil stops for material, over the **7 1/2 pound** limit referred to above, may be lampwicking or canvas thoroughly saturated with red lead and shellac mixture or lampwicking or canvas soaked in a mixture of pine tar and shellac. For material of **7 1/2 pounds** and less oil stops shall be of **10-ounce** canvas soaked for one-half day in clear shellac, then coated with the above red-lead and shellac mixture, or of **10-ounce** canvas soaked in a mixture of pine tar and shellac.

23. The materials of stop waters may be as specified for oil stops.

24. Other materials may be used for stop waters and oil stops when specifically authorized.

Stop waters, use of.

Material of stop waters.

Oil stops, use of.

Material of oil stops.

Alternative materials, stop waters.

Use of materials other than specified.

Materials to be fresh when used. **25.** The materials used in preparing stop waters and oil stops must be fresh and the work in way thereof must be riveted up before the material has hardened.

BOLTING AND RIVETING.

Bolting up. **26.** The proportion of bolts used relative to the number of rivet holes shall be as approved. The work shall in all cases be carefully closed before the riveting is commenced. In oil-tight work, generally, one bolt should be fitted for every four rivet holes.

Condition of work. **27.** All burrs and chips shall be removed, and buckles and lumps shall be faired out before any riveting is done.

Suitability of rivets. **28.** The rivets shall be properly proportioned for the holes, and they shall be of sufficient length in every case to insure a satisfactory point. Such cutting as is necessary should be done while the rivet is still a dull red, the points are to be left full and must not finish below the surface of the material.

Heating of rivets. **29.** Care should be taken that rivets be not burnt when heating. Burnt rivets which are driven shall be cut out.

Use of power in riveting. **30.** In oil-tight work all rivets, as far as practicable, should be power driven. Where rivets are driven by power, the holding-on should also be by power.

Rivet points. **31.** All points shall be of adequate strength and properly centered, following, as nearly as practicable, the standard dimensions given on **page 42**. Snap points shall not be reduced from the standard sizes by using tools that have been ground down from proper sizes or that are otherwise imperfect.

Rivets driven cold. **32.** Rivets less than **3/8 inch** in diameter may be driven cold. In watertight joints where such riveting is employed canvas stops soaked in red lead or other approved mixture shall be fitted to secure tightness.

Testing rivets. **33.** All rivets driven shall be tested. Wherever found, loose rivets, burned rivets, rivets with slack or eccentric points, cracked or eccentric heads or with heads standing off from the surface shall be replaced.

TYPES OF RIVETS.

34. The standard types of heads and points are illustrated on pages 37-42; these should be followed so far as practicable. The use of other than standard types of rivets shall be subject to approval. The use of the respective standard types shall be in general accordance with the following table:

Types.	Class of work where used and detailed requirements as to types.
Pan heads	In all work, except where other types are permitted or required.
Button heads ...	In casings, etc., where required for finished appearance and when approved to suit types of power-riveting apparatus employed.
Countersunk heads.	Where flush surfaces are required; in staples and boundary bars, etc., where oil or water tightness is required and where the heads of rivets may require calking. In work where countersunk heads are employed solely for the purpose of providing for calking, the raised countersunk type is preferred.
Coned necks	In all work with pan or button head rivets $1\frac{1}{2}$ inch diameter or over, except where otherwise approved.
Straight necks ...	In conjunction with drilled or reamed holes only.

Types.	Class of work where used and detailed requirements as to types.
Countersunk points.	<p>Where flush surfaces are required and where the rivet point may require calking.</p> <p>In outside plating these points shall generally be such that while not forming a distinct projection they shall be full enough to hold a rule or straightedge off from the surface of the material. They should not in any work finish below the surface of the plates or shapes. Particular care should be taken in regard to compliance with the foregoing requirement in vessels of light construction.</p>
Snap points.....	<p>In framing and structural work generally, where flush surfaces are not required.</p> <p>This type of rivet may also be required in sheer strakes of outside plating, etc., when strength is of special importance, in order to avoid loss of material by countersinking.</p>
Hammered points.	Where specially approved or required.
Oval (Liverpool) points.	In exposed finished surfaces with material less than 7½ pounds, where watertightness under pressure is not required, this type may be used instead of the countersunk type.

Types.	Class of work where used and detailed requirements as to types.
Tap rivets.....	<p>In connections of plates and shapes to armor, forgings, castings, and other material where use of through rivets is not practicable.</p> <p>These rivets may also be used as through rivets for attachments to outside of shell plating when plating is over 15 pounds nominal weight; in this case they shall be tapped into the plating and set up on the inside with nut, washer, and grommet.</p>

SIZES OF RIVETS.

35. The size of punches, dies, reamers, and rivets shall be in accordance with the following table:

Rivet	Holes, punched. (A) Where subject to test requirements for oil tightness. (B) Where strength is of special importance. (C) In three or more thicknesses of material.				Holes, punched. In work not included in (A, B, and C) of foregoing.			Holes drilled small, not in place and reamed.		Holes drilled full size, in place.	Nominal weight of plates in pounds.
	Punch.	Die.	Reamer.		Punch.	Die.	Reamer.	Drill.	Reamer.	Drill.	
In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	In.	
1/4	7/32	1/4	9/32	1/4	9/32	9/32	1/4	9/32	9/32	9/32	Up to 3, exclusive.
3/8	11/32	3/8	13/32	3/8	13/32	13/32	3/8	13/32	13/32	13/32	From 3 to 6, inclusive.
1/2	7/16	1/2	9/16	1/2	9/16	9/16	1/2	9/16	9/16	9/16	Over 6 to 8-1/2, incl.
5/8	9/16	5/8	11/16	5/8	11/16	11/16	5/8	11/16	11/16	11/16	Over 8-1/2 to 12-1/2, incl.
3/4	11/16	3/4	13/16	3/4	13/16	13/16	3/4	13/16	13/16	13/16	Over 12-1/2 to 19, incl.
7/8	13/16	7/8	15/16	7/8	15/16	15/16	7/8	15/16	15/16	15/16	Over 19 to 29, incl.
1	15/16	1	1-1/16	1	1-1/16	1-1/16	1	1-1/16	1-1/16	1-1/16	Over 29 to 39, incl.
1-1/8	1-1/16	1-1/8	1-3/16	1-1/8	1-3/16	1-3/16	1-1/8	1-3/16	1-3/16	1-3/16	Over 39 to 49, incl.
1-1/4	1-3/16	1-1/4	1-5/16	1-1/4	1-5/16	1-5/16	1-1/4	1-5/16	1-5/16	1-5/16	Over 49.

Vessels of special light construction.

36. In vessels of special light construction rivets of smaller diameters than those given by the above table may be used, subject to approval, where the flange of shape to which the plates are connected is not of sufficient width for the standard diameter.

Connection of different thicknesses.

37. Where plates of different thicknesses, which form part of a vessel's ordinary structure, are connected together, the size of rivets and the spacing where strength is of primary importance, shall be that required for the thicker plate. If water-tightness or oil-tightness is of primary importance, the size of rivets and the spacing shall be that corresponding to the thinner plate; if the thicker plate is more than double the thickness of the thinner, an intermediate size of rivet shall be used. Where, in a vessel's ordinary structure, the plates and angles or other shapes connecting thereto are of different thicknesses, the size and the spacing of rivets, in general, shall be that corresponding to the thickness of the plating.

Rivets in stems and sternposts.

38. Through rivets in stems, sternposts, and heavy castings shall be **1/8 inch** larger than required for the plates connected thereto.

3-ply and 4-ply riveting.

39. Except in the case of double-strapped butts, the rivets for **3-ply** and **4-ply** riveting may be **1/8 inch** larger than the sizes required by the table on **page 15**, in order to facilitate drawing the material together.

Double-strapped butts.

40. In double-strapped butts, where the plating joined is **25 pounds** or less, the rivets shall be one size smaller than given for the plating on **page 15**.

Tap rivets.

41. Tap rivets shall be **1/8 inch** larger than the ordinary rivets required for the material in which the countersink occurs, except that taps into heavy forgings or castings shall be **1/4 inch** larger.

BUTT CONNECTIONS, ROWS OF RIVETING FOR.

42. The following table is given for ready reference to indicate, in general, the number of rows of rivets to be used for butt connections in plates of various weights. The tables on pages 31—35 give the calculated efficiencies of joints and shall be used where special strength is required.

Connections.	Weights of plates, nominal, in pounds.	Riveting. (Symbols used: /, single row; / /, double row, etc.)
Single-butt straps and butt laps.	Under 7 1/2-----	/
	7 1/2 and under 15--	/ /
	15 and under 25---	/ / /
	25 and under 35---	/ / / /
	35 and under 50---	/ / / / /, or / / / / / with alternate rivets or wide spacing in outer row.
	50 and over-----	As approved.
Double-butt straps.	15 and under 20---	/ / - / / or / / / - / / /
	20 and under 30---	/ / / - / / /
	30 and under 50---	/ / / / - / / / /
	50 and over-----	As approved.

43. In single and double strapped butts with treble riveting and over, the type of butt with alternate rivets in the outer row omitted or with wider spacing in the outer row should be used wherever practicable. Where this is not practicable in the case of double-butt straps, a "special" type of butt connection in accordance with the following table may be used. In these "special" butt

connections the strap on the calking side shall take one less row of rivets than that on the opposite side, the alternate rivets of the outermost row in the wider strap being omitted.

Connections.	Weights of plates, nominal, in pounds.	Riveting. (Symbols used: <i>//</i> - <i>///</i> , calked strap, double riveted; uncalked strap, treble riveted, etc.)
Double-but straps, "Special."	20 and under 30 . . . 30 and under 45 . . . 45 and over	<i>//</i> - <i>///</i> <i>///</i> - <i>////</i> As approved.

ARRANGEMENT OF RIVETS IN ROWS. .

In plates.

44. Chain riveting shall be used generally where two or more rows of rivets are required in butts and seams of plating, except in vessels of special light construction where, in general, zigzag riveting shall be used.

In shapes.

45. Zigzag riveting shall be used in shapes where two or more rows are required.

DISTANCES BETWEEN ROWS OF RIVETS, AND TO EDGES OF PLATES AND SHAPES.

Distance between rows.

46. In seams and single butt straps the distance from center to center of rows for chain riveting shall be not less than $2 \frac{1}{2}$ diameters.

47. In butt laps and double butt straps, where chain riveted, the distance between centers of rows shall be not less than 3 diameters.

Zigzag riveting.

48. In zigzag riveting of plates, straps, and shapes generally, the distances between centers of rows shall not be less than as given in the following table:

Spacing in rivet diameters.	
	Between rows.
For 3 1/2 in rows.....	1 1/2
For 4 in rows.....	1 3/4
For 4 1/2 in rows.....	1 7/8
For 5 in rows.....	1 7/8
For 5 1/2 in rows.....	2
For 6 in rows.....	2

49. Centers of rivets shall be not less than **1 5/8 times** the diameter from the edges of plates or straps. In angles and other shapes the same distance from the edge shall be maintained; except that, where the angles or shapes are planed or chipped to obtain a calking edge, the distance from edge to center of rivets may be **1 1/2 times** the rivet diameter. Distance of rivets from edges.

50. The centers of taps from the edge of plates and shapes should not be a less distance than that required by the **1/8-inch** less size of rivets for which they are substituted. Where taps are **1/4 inch** larger than rivets they should, in general, be **1 5/8 diameters** from edge. (See paragraph 41.) Distances for taps.

PLATE LAPS AND BUTT AND SEAM STRAPS.

51. The widths of laps and straps shall be not less than required by the foregoing and should not exceed same by more than **1/8 inch** for each row of rivets in the connections. Width of laps and straps.

52. Single butt and seam straps, when single or double riveted, shall be of the same thickness as the plates connected. Single butt straps, when treble riveted or over, shall be at least **1.2 times** the thickness of plates which they connect. Thickness, single butt and seam straps.

Thickness, double butt straps.

53. Double straps, where double riveted, shall be each $\frac{1}{2}$ the thickness of the plate they connect. Where treble riveted and over they will each be $\frac{5}{8}$ the thickness of the plate. Where double straps are of the "special" type, having outer and inner straps of different widths, they shall each be $\frac{5}{8}$ the thickness of the plate.

Thickness of straps increased if rivet holes are countersunk.

54. Where rivet holes in ordinary double riveted double straps are countersunk, the weight of the countersunk strap shall be increased to $\frac{5}{8}$ the thickness of the plate to compensate for loss of material.

Where plates strapped are of different thicknesses.

55. Where the plates connected are of different thicknesses, the thickness of butt or seam straps shall be governed by the lighter plate.

SPACING OF RIVETS IN ROWS.

56. The spacing of rivets, in rows, as far as practicable, shall be in accordance with the following table:

Connections.	Riveting. (Symbols used: /, single row; //, double, etc.)	Spacing in rivet diameters.
Plating: Seam laps and seam straps.	WATERTIGHT.	
	/	3 $\frac{1}{2}$
	//, 10 pounds weight and under.....	4
	//, and ///, over 10 pounds weight.....	4 $\frac{1}{2}$
	NON-WATERTIGHT.	
	/	4 $\frac{1}{2}$
	//, or over	5
	OIL-TIGHT.	
	Throughout	3 $\frac{1}{2}$

Con- nec- tions.	Riveting. (Symbols used :/, single row; //, double, etc.)	Spacing in rivet diameters.
<i>Plating:</i> Single butt straps and butt laps.	<p style="text-align: center;">WATER-TIGHT.</p> <p><i>I</i> ----- 3 1/2</p> <p><i>II</i> ----- 4</p> <p><i>III</i>, all rows complete ----- 4 1/2</p> <p><i>III</i>, alternate rivets omitted in outer row, 16 pounds and under 4</p> <p><i>III</i>, alternate rivets omitted in outer row, over 16 pounds ----- 3 1/2</p> <p><i>IIII</i>, all rows complete ----- 4 1/2</p> <p><i>IIII</i>, alternate rivets omitted in outer row, under 35 pounds ----- 4</p> <p><i>IIII</i>, alternate rivets omitted, or wide spacing, in outer row, 35 pounds and over ----- 3 1/2</p> <p><i>IIIII</i>, all rows complete ----- 5</p> <p><i>IIIII</i>, alternate rivets omitted, or wide spacing, in outer row under 45 pounds ----- 4 1/2</p> <p>45 pounds and over, with alter- nate rivets omitted in outer row 4</p>	
	<p style="text-align: center;">NONWATER-TIGHT.</p> <p><i>I</i> ----- 4 1/2</p> <p><i>II</i>, or over ----- As for W.T.</p>	
	<p style="text-align: center;">OIL TIGHT.</p> <p>In general ----- 3 1/2</p> <p>Wider spacing than 3 1/2 rivet di- ameters may be used if directed or approved.</p>	

Connections.	Riveting. (Symbols used: <i>//-//</i> , double riveted; <i>///-///</i> , treble riveted, etc.)	Spacing in rivet diameters.
<i>Plating:</i> Double butt straps.	WATER-TIGHT. <i>//-//</i> , rows complete ----- <i>///-///</i> , all rows complete ----- <i>////-////</i> , all rows complete -----	4 4 1/2 5
	NONWATER-TIGHT. <i>///-///</i> , alternate rivets omitted in outer row, under 25 pounds -- <i>///-///</i> , alternate rivets omitted in outer row, 25 pounds and under 30 ----- <i>////-////</i> , alternate rivets omitted in outer row, 45 pounds and under ----- <i>////-////</i> , alternate rivets omitted in outer row, over 45 pounds -----	5 4 1/2 5 4 1/2
	OIL TIGHT. In general ----- Wider spacing than 3 1/2 rivet di- ameters may be used if directed or approved.	3 1/2

Connections.	Symbols used: <i>//</i> - <i>///</i> , double-riveted strap on calking side, and treble-riveted strap on noncalking side, etc.— <i>/</i> , single row; <i>//</i> , double, etc.	Spacing in rivet diameters.
<i>Plating:</i> Double butt straps, “special.”	<p style="text-align: center;">WATER-TIGHT.</p> <p><i>//</i>-<i>///</i>, alternate rivets omitted in outer row.....</p> <p><i>///</i>-<i>////</i>, alternate rivets omitted in outer row.....</p>	<p style="text-align: center;">4 1/2</p> <p style="text-align: center;">5</p>
	<p style="text-align: center;">OIL TIGHT.</p> <p>In general.....</p> <p>Wider spacing than 3 1/2 rivet diameters may be used if directed or approved.</p>	<p style="text-align: center;">3 1/2</p>
Angles to plates, including staples.	<p style="text-align: center;">WATER-TIGHT.</p> <p><i>/</i>, plate, or angle, 15 pounds and under.....</p> <p><i>/</i>, plate, or angle, over 15 pounds.....</p> <p><i>//</i>, plate, or angle, 15 pounds and under.....</p> <p><i>//</i>, plate, or angle, over 15 pounds.....</p>	<p style="text-align: center;">4 1/2</p> <p style="text-align: center;">5</p> <p style="text-align: center;">5</p> <p style="text-align: center;">5 1/2</p>
	<p style="text-align: center;">OIL TIGHT.</p> <p><i>/</i>, and <i>//</i>, in general.....</p> <p>Wider spacing than 4 rivet diameters may be used if directed or approved.</p>	<p style="text-align: center;">4</p>

Connections.	Symbols used: <i>I</i> , single row; <i>II</i> , double, etc.	Spacing in rivet diameters.
Angles to plates.	NONWATER-TIGHT.	
	<i>I</i> , or over, for strength connections generally, including face plates and reinforcing bars to stiffeners, etc.	5
	<i>I</i> , or over, for bulkhead boundary bars, stiffeners, and connections where strength is not of special consideration	8

57. The spacing of rivets in rows, in the locations given in the following table, shall be used only as additions and exceptions to the foregoing general table:

Structure.	Connections and riveting. (Symbols used: <i>I</i> , Single row; <i>II</i> , double, etc.)	Spacing in rivet diameters.
Vertical keel, where non-water-tight.	<i>I</i> , plates to outer and inner angles; angles to flat keel and to rider plate beyond inner bottom	7
	<i>I</i> , to inner bottom	5
Longitudinals, where non-water-tight.	<i>I</i> , to outside plating	8
	<i>I</i> , to inner bottom	5
	<i>I</i> , plates to outer and inner angles ..	7

Structure.	Connections and riveting. (Symbols used: /, Single row; //, double, etc.)	Spacing in rivet diameters.
Trans- verse framing where non- water- tight.	/, frames to outside plating	8
	/, reverse frames to inner bottom ..	5
	/, floor plates, lightened and solid, to clips on longitudinals and in connections to frames and re- verse frames, etc	7
	/, floor plates, lightened and solid, to clips on vertical keel, and on longitudinals in wake of dock- ing keels	5
	/, floor plates, flanged bracket type, to clips on longitudinals and ver- tical keel, and in connections to frames and reverse frames	5
Decks and plat- forms.	//, floor plates, flanged bracket type, to clips on longitudinals and vertical keel, and in con- nections to frames and reverse frames	7
	/, beam knees (ordinary)	4
	//, beam knees (ordinary)	8
	/, plating to beams below the low- est complete water-tight deck, and elsewhere in way of auxili- ary machinery	5
	/, plating to beams on and above lowest complete water-tight deck ..	8

Structure.	Connections and riveting. (Symbols used: /, Single row; //, double, etc.)	Spacing in rivet diameters.
W. T. and O. T. bulk- heads below lowest complete W. T. deck.	/ , stiffeners on noncalking side of bulkhead / , stiffener if calked water-tight... / , stiffener if calked oil-tight / , stiffeners on both sides of bulk- head, through riveted	6 5 4 1/2 4
W. T. and non- W. T. bulk- heads above lowest complete W. T. deck.	/ , seams, water-tight plating / , and over, plating nonwater-tight, 5 pounds and under, to angles and deck beams / , stiffeners / , boundary bars to sheer strake, stringer plate, and other impor- tant longitudinal strength mem- bers	4 4 1/2 8 8
Seat- ings.	/ , and over, for engines, boilers, air compressors, etc.	6

Structure.	Connections and riveting. (Symbols used: /, Single row; //, double, etc.)	Spacing in rivet diameters.
In way of armor.	/, brackets, beam knees, and web frames -----	3 1/2
	//, brackets, beam knees, and web frames -----	7
	/, and over. In horizontal flanges of angles behind armor, without backing: Barbettes, conning towers, etc., to decks -----	3 1/2
	/, and over. In horizontal flanges of angles behind transverse armor to decks -----	As approved.
	/, and over. In vertical flanges of deck angles behind armor, without backing -----	4
Turrets, and foundations for turrets and guns.	//, and over. In butt straps connecting armor plates, without backing -----	As required by table for single butt straps.
	/, and over. In structural work generally, rivets in shear -----	5
	/, and over. In structural work generally, rivets in tension -----	4
	/, and over. Supporting structures in way of turret and gun foundations, including bulkheads and stiffeners -----	5

Structure.	Connections and riveting. (Symbols used: /, Single row; //, double row.)	Spacing in rivet diameters.
Miscellaneous and general.	Quilting rivets, as approved	8 to 16
	<p style="text-align: center;">ANGLES.</p> <p>Angles entering into the continuous longitudinal strength of the vessel shall in general be strapped at butts with a bosom bar having at least three rivets on each side of the butt for every row of rivets. The rivet holes in such bars shall, as far as practicable, be kept out of line transversely in order to avoid reductions of the longitudinal strength.</p>	
	<p style="text-align: center;">BULKHEAD LINERS.</p> <p>Liners at bulkheads shall be so riveted that the longitudinal strength of the structure through a water-tight or oil-tight frame will be equal to the strength at a nonwater-tight frame. The rivets shall be suitably spaced around the perimeter of the liner for oil or water tightness as may be required. When directed, or approved, only the alternate rivets in the boundary bar in way of the liner shall extend through the plating.</p>	

58. Where the spacing in rows as given in preceding tables can not be followed exactly, the general practice should be to space closer, as may be necessary, to obtain equal divisions, but in no case shall the spacing in rows be closer than three diameters. Modifications of spacing.

CALCULATED JOINTS.

59. Where the strength of joints is calculated this shall be done in accordance with the following instructions. If for special reasons adherence to these instructions for calculations is considered inadvisable, the matter shall be referred to the Bureau.

60. The strength of the joint, so far as practicable, shall be equal to the strength through an adjacent line of non-watertight spaced rivets in the same member Basis for strength.

61. For medium steel plates the value of 63,000 pounds per square inch shall be used for the unit tensile strength. Tensile strength of medium steel.

62. For high tensile steel plates, the value to be used for the unit tensile strength shall be the same as the minimum tensile strength specified for the material. Tensile strength, high tensile steel.

63. For calculated joints in special treatment steel the method proposed to be used shall be specifically referred to the Bureau. Joints in special treatment steel.

64. The following values shall be used for the unit shearing strength of the rivets, in single shear:

Medium steel rivets in medium steel plates	50,000	Shearing strength, single shear.
Medium steel rivets in high tensile steel plates . . .	43,000	
High tensile steel rivets in high tensile steel plates.	64,000	

65. The value of a rivet in double shear shall be taken as one and eight-tenths times the value given in paragraph 64 for single shear. Shearing strength, double shear.

Area of rivet for shear. **66.** The shearing strength shall be based upon the tabulated size of the rivet hole and not the diameter of the rivet before it is driven.

Bearing value. **67.** The bearing value when required in connection with these calculations shall be taken as double the shearing strength of the material.

EFFICIENCIES OF JOINTS.

68. The following tables of efficiencies of joints are based upon an assumed ratio, tensile strength of plate to shearing strength of rivets, of 63 to 50. Countersinking, where allowed for, is taken as extending the full thickness in all weights of material. Efficiencies are for joints of indefinite extent and do not cover special conditions which may occur in the case of a particular joint required to be of maximum strength.

EFFICIENCIES OF JOINTS.

LAPS AND SINGLE STRAPS.

Rivet diameters, in inches.	Weights of plates, in pounds.	ALL RIVET ROWS COMPLETE.													
		/	//	///	////	/////									
		Spacing of rivets in rows—rivet diameters.													
		3½	4½	3½	4	3½	4	4½	3½	4	4½	3½	4	5	
½	{	7	a.62	.51	a.62	a.67									
		7½	.61	.48	a.62	a.67									
		8	.58	.45	a.61	a.66									
		8½	.54	.42	a.61	a.66									
	{	9	.51	.40	a.61	a.66									
		8½	a.63	.50	a.63	a.68									
		9	.61	.48	a.63	a.67									
		10	.55	.43	a.62	a.67									
¾	{	11	.50	.39	a.61	a.66									
		12	.46	.36	a.61	a.66									
		12½	.44	.34	a.60	a.65									
		13	.42	.33	a.60	a.65									
¾	{	12½	.51	.40	a.64	a.69									
		13	.50	.39	a.64	a.69	a.64	a.69	a.72						
		14	.46	.36	a.64	a.68	a.64	a.68	a.72						
		15	.43	.33	a.63	a.68	a.63	a.68	a.71						
¾	{	16	.40	.31	a.63	a.63	a.63	a.63	a.71						
		18	.36	.28	a.62	.62	a.62	a.67	a.71						
		19	.34	.26	a.62	.59	a.62	a.66	a.70						
		20	.32	.25	a.61	.56	a.61	a.66	a.70						
¾	{	19			a.63	.67	a.63	a.68	a.71						
		20			a.63	.64	a.63	a.67	a.71	a.63	a.67	a.71			
		22½			a.62	.57	a.62	a.67	a.70	a.62	a.67	a.70			
		25			.58	.51	a.61	a.66	.63	a.61	a.66	a.70	a.61	a.66	a.73
¾	{	27½			.53	.46	a.60	a.65	.62	a.60	a.65	a.69	a.60	a.65	a.72
		29			.50	.45	a.60	a.65	.59	a.60	a.65	a.68	a.60	a.65	a.72
		30			.49	.43	a.59	.64	.57	a.59	a.65	a.68	a.59	a.65	a.72
		29					a.63	a.67	.66	a.63	a.67	a.70	a.63	a.67	a.73
1	{	30					a.63	a.67	.64	a.63	a.67	a.71	a.63	a.67	a.74
		32½					a.62	.66	.59	a.62	a.67	a.71	a.62	a.67	a.73
		35					a.61	.62	.55	a.61	a.66	a.70	a.61	a.66	a.73
		37½					a.61	.57	.51	a.61	a.66	.68	a.61	a.66	a.73
1	{	39					a.61	.55	.49	a.61	a.65	.65	a.61	a.65	a.72
		40					a.60	.54	.48	a.60	a.65	.64	a.60	a.65	.72
		39					a.62	.61	.55	a.62	a.67	a.70	a.62	a.67	a.73
		40					a.62	.60	.53	a.62	a.66	a.70	a.62	a.66	a.73
1 1/8	{	42½					a.61	.56	.50	a.61	a.66	.67	a.61	a.66	a.73
		45					a.60	.53	.48	a.60	a.65	.64	a.60	a.65	.71
		47½					a.60	.50	.45	a.60	a.65	.60	a.60	a.65	.67
		49					.56	.49	.43	a.60	a.65	.58	a.60	a.65	.65
1 1/8	{	50					.55	.48	.43	a.59	.64	.57	a.59	a.65	.64

a Plate weaker than rivets.

Holes in plates countersunk

EFFICIENCIES OF JOINTS.

SINGLE STRAPS.

Rivet diameters, in inches.	Weights plates, in pounds.	ALTERNATE RIVETS IN OUTER ROW OMITTED.										WIDE-SPACED RIVETS IN OUTER ROW.					
		///			////			/////				///	////	/////	/////		
		Spacing of rivets in rows—rivet diameters.															
		3½	4	4½	3½	4	4½	3½	4	4½	3 1/2, & 5 1/4 in outer row.	3 1/2, & 5 1/4 in outer row.	4 & 6 in outer row.	3 1/2, & 5 1/4 in outer row.	4 1/2, & 6 3/4 in outer row.		
½	{	7	a.81	a.83	a.85												
		7½	a.81	a.83	a.85												
		8	a.81	a.83	a.85												
		8½	a.80	a.83	a.85												
		9	a.80	a.83	a.85												
5/8	{	9	a.81	a.84	a.86												
		10	a.81	a.83	a.85												
		11	a.81	a.83	a.85												
		12	a.80	a.83	a.85												
		13	a.80	a.83	.82												
¾	{	13	a.82	a.84	a.86												
		14	a.82	a.84	a.86												
		15	a.82	a.84	.83												
		16	a.81	a.84	.78							a.75	a.75	a.78	a.75	a.81	
		18	b.80	.78	.69												
7/8	{	19	b.79	.74	.66												
		20	b.77	.70	.62							a.74	a.75	a.77	a.75	a.81	
		19	a.82	a.84	.75												
		20	b.81	.80	.71	b.81	b.83	b.85				a.75	a.75	a.78	a.75	a.81	
		22½	b.87	.71	.63	b.78	b.81	.83									
1	{	25	.73	.64	.57	b.76	b.79	.80	b.76	b.79	b.81	a.74	a.74	a.77	a.74	a.80	
		27½	.66	.58	.52	b.74	b.77	.72	b.74	b.77	b.79						
		29				.63						.67					
		30	.61	.53	.47	b.72	b.75	.68	b.72	b.75	b.78	.65	a.73	a.76	a.73	a.79	
		30	.68	.60	.53	b.76	b.79	.74	b.76	b.79	b.82	.73	a.75	a.78	a.75	a.81	
1 1/8	{	32½				b.75	.77	.69	b.75	b.78	b.80	.67					
		35				b.73	.72	.64	b.73	b.77	b.79	.63	a.74	.75	a.74	a.80	
		37½				b.72	.67	.60	b.72	b.75	.77	.58		.70			
		39					.64	.57				.74	.56		.68		
		40				b.71	.63	.56	b.71	b.74	.72	.55	a.74	.66	a.74	.74	
1 1/4	{	39				b.73	.70	.62	b.73	b.76	b.79	.61	a.74	.73	a.74	a.80	
		40				b.72	.66	.58	b.72	b.75	.75	.57		.69		.78	
		42½				b.71	.62	.55	b.71	b.74	.71	.54	a.74	.65	a.74	.74	
		45					.67	.59	.52	b.70	b.73	.67	.51	.70		.70	
		47½				.65										.68	
1 1/2	{	49				.64	.56	.50	b.69	b.72	.64	.49	.67	.58	a.72	.66	
		50															

^a Plate tears in outer row.

^b Plate tears and rivets shear in outer row

Holes in plates countersunk.

EFFICIENCIES OF JOINTS.

DOUBLE STRAPS.

		ALL RIVET ROWS COMPLETE.									
Rivet diameters, in inches.	Weights of plates, in pounds.	11-11		111-111			1111-1111		11111-11111		
		Spacing of rivets in rows—rivet diameters.									
		4	4½	4	4½	5	4	5	4	5½	
5/8	{	15	a.73	a.76	a.73	a.76	a.78	a.73	a.78	a.73	a.80
		16	---	a.76	---	---	---	---	---	---	---
		18	---	a.76	---	---	---	---	---	---	---
		20	a.73	a.76	a.73	a.76	a.78	a.73	a.78	a.73	a.80
3/4	{	20	a.73	a.76	a.73	a.76	a.78	a.73	a.78	a.73	a.80
		22½	---	a.76	---	---	---	---	---	---	---
		25	a.73	.72	a.73	a.76	a.78	a.73	a.78	a.73	a.80
7/8	{	25	a.73	a.76	a.73	a.76	a.79	a.73	a.79	a.73	a.81
		27½	---	.74	---	---	---	---	---	---	---
		30	a.73	.68	a.73	a.76	a.79	a.73	a.79	a.73	a.81
1	{	30	a.73	a.76	a.73	a.76	a.79	a.73	a.79	a.73	a.81
		32½	---	.71	---	---	---	---	---	---	---
		35	a.73	.66	a.73	---	a.79	a.73	a.79	a.73	a.81
		37½	.69	.61	---	---	.79	---	---	---	---
		40	.65	.57	a.73	a.76	.78	a.73	a.79	a.73	a.81
1 1/8	{	40	.72	.64	a.74	a.77	a.79	a.74	a.79	a.74	a.81
		42½	.68	.60	---	---	a.79	---	---	---	---
		45	.64	.57	a.74	---	.77	a.74	a.79	a.74	a.81
		47½	.60	.54	---	---	.73	---	---	---	---
		50	.57	.51	a.74	a.77	.69	a.74	a.79	a.74	a.81

a Plate weaker than rivets.

No countersinking of rivet holes.

EFFICIENCIES OF JOINTS.
DOUBLE STRAPS.

Rivet diameters, in inches.	Weights of plates, in pounds.	ALTERNATE RIVETS IN OUTER ROW OMITTED.						Wide-spaced rivets in outer row.		
		///-///		////-////		///// - /////		////- ////	///// - /////	
		Spacing of rivets in rows—rivet diameters.								
		4	4½	5	4½	5	5	4½, and 6¼ in outer row.	5, and 8 in outer row.	
1	{	15	a.88	a.89						
		16	a.86	a.89						
		18		a.89						
		20	a.86	a.88	.87					
	{	20	a.88	a.89						
		22½	a.86	a.89						
		25	a.88	.81	a.88	a.89	a.89	a.84	a.86	
	{	25	a.87	a.88	a.89	a.88	a.89	a.89	a.84	a.87
		27½		a.88	.84					
		30	a.87	.85	.77	a.88	a.89	a.89	a.84	a.87
	{	30	a.87	a.88	.86	a.88	a.89	a.89	a.84	a.87
		32½		a.88	.80					
		35	a.87	.82	.74	a.88	a.89	a.89	a.84	a.87
		37½		.77	.69					
		40	.81	.72	.65	a.88	a.89	a.89	a.84	a.87
	{	40	a.87	.80	.72	a.88	a.89	a.89	a.84	a.87
		42½		.75	.68					
		45	.80	.71	.64	a.88	a.89	a.89	a.84	a.87
		47½		.67	.60		.85			
		50	.72	.64	.57	a.88	.80	a.89	a.84	a.87

a Plate tears in outer row.

No countersinking of rivet holes.

EFFICIENCIES OF JOINTS.
DOUBLE STRAPS "SPECIAL."

Rivet diameters, in inches.	Weights of plates, in pounds.	1 1-1 1 1			1 1 1-1 1 1 1		
		Calked strap, double riveted, rows complete; noncalked strap, treble riveted, alternate rivets omitted in outer row.			Calked strap, treble riveted, rows complete; noncalked strap, quadruple riveted, alternate rivets omitted in outer row.		
		Spacing of rivets in rows—rivet diameters.					
		3½	4	4½	4	4½	5
5/8	{ 20	a.82	b.85	a.86			
3/4	{ 20 22½ 25	b.85 a.83 a.82	b.86 a.85 a.84	b.88 a.87 .82			
					a.84	a.86	a.87
7/8	{ 25 27½ 30	a.84 a.82	a.86 a.84	a.88 a.87 .78	a.86 a.85 a.84	a.88 a.86	a.89 a.88 a.87
1	{ 30 32½ 35 37½ 40	a.83 a.81 a.80	a.85 a.84 .74	a.87 .81 .75 .70 .65	a.85 a.84 a.84 a.83 a.82	a.87 a.86	a.88 a.88 a.87 a.86 .85
1 1/8	{ 40 42½ 45 47½ 50	a.81 a.80 .75	.82 .73 .65	.73 .68 .65 .61 .58	a.84 a.83 a.82 a.82 a.82	a.85 a.84	a.87 a.86 .84 .79 .75

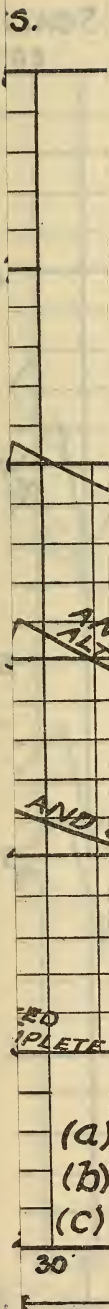
a Plate tears and rivetsshear in outer row.*b* Plate tears in outer row.

No countersinking of rivet holes.

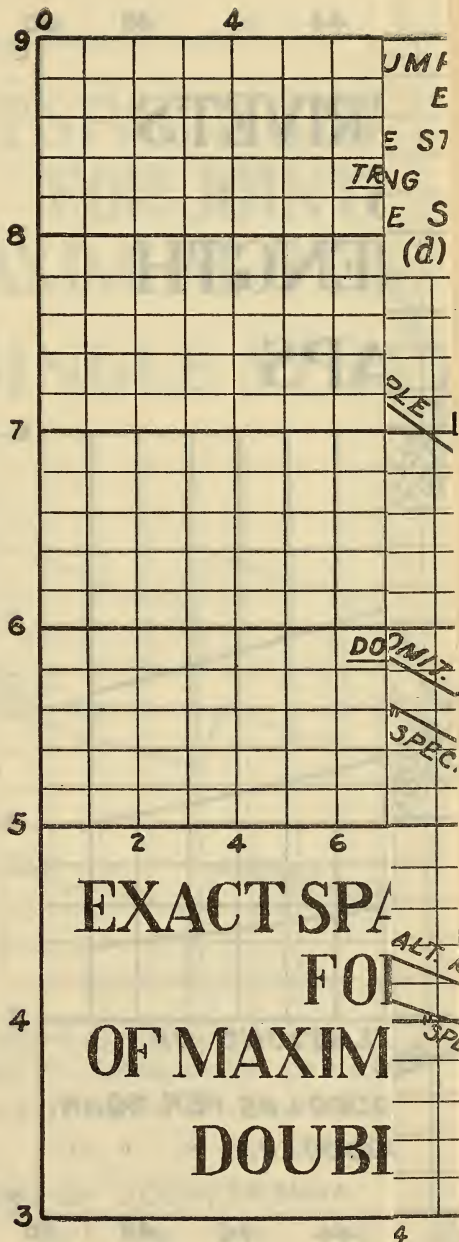
EXACT SPACING FOR JOINTS OF MAXIMUM STRENGTH.

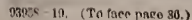
69. The following plates (1 and 2) contain curves of exact spacing of rivets for use in calculating joints of maximum strength.

SCALE OF SPACING IN DIAMETERS OF RIVETS.



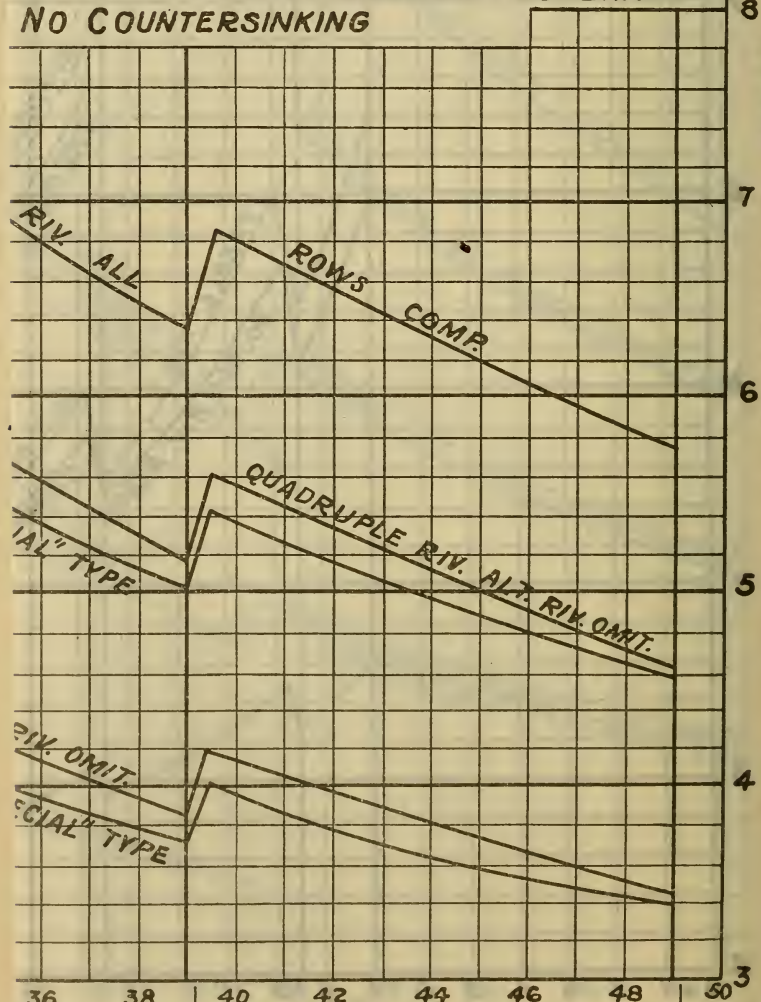
SCALE OF SPACING IN DIAMETERS OF RIVETS.





36 40 44 48 50 9

PTIONS FOR CALCULATIONS OF
 EXACT SPACINGS GIVEN
 LENGTH OF PLATE 63,000 LBS. PER. SQ. IN.
 " " RIVETS 50,000 " " " "
 HEAR " " 1.8 SINGLE SHEAR
 NO COUNTERSINKING

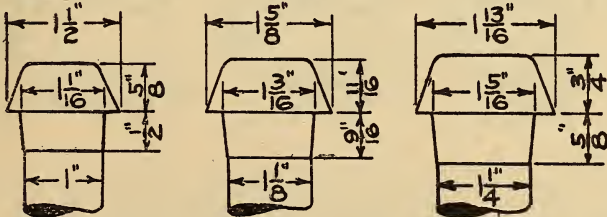
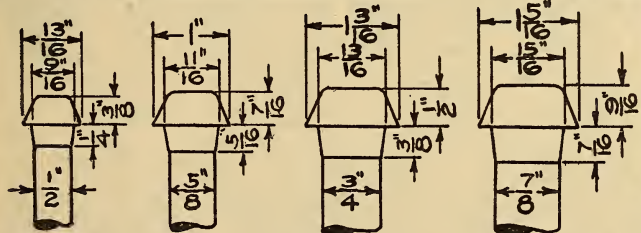
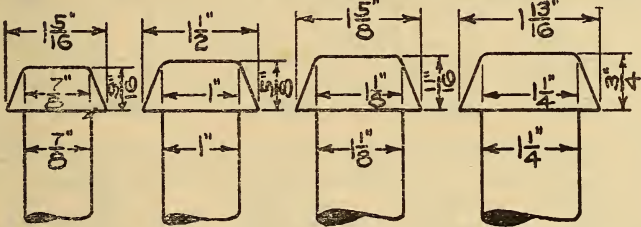
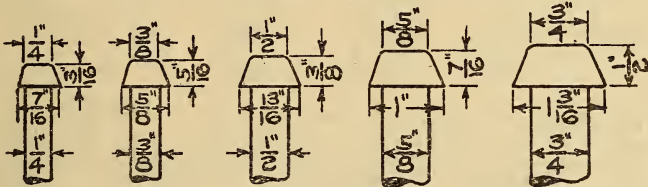


36 38 40 42 44 46 48 50 3
 S ——— $\frac{1}{8}$ " RIVETS ——— $\frac{1}{4}$ " RIV.

STANDARD TYPES OF RIVET HEADS AND POINTS.

70. The sizes and proportions of standard rivets are illustrated on the following pages:

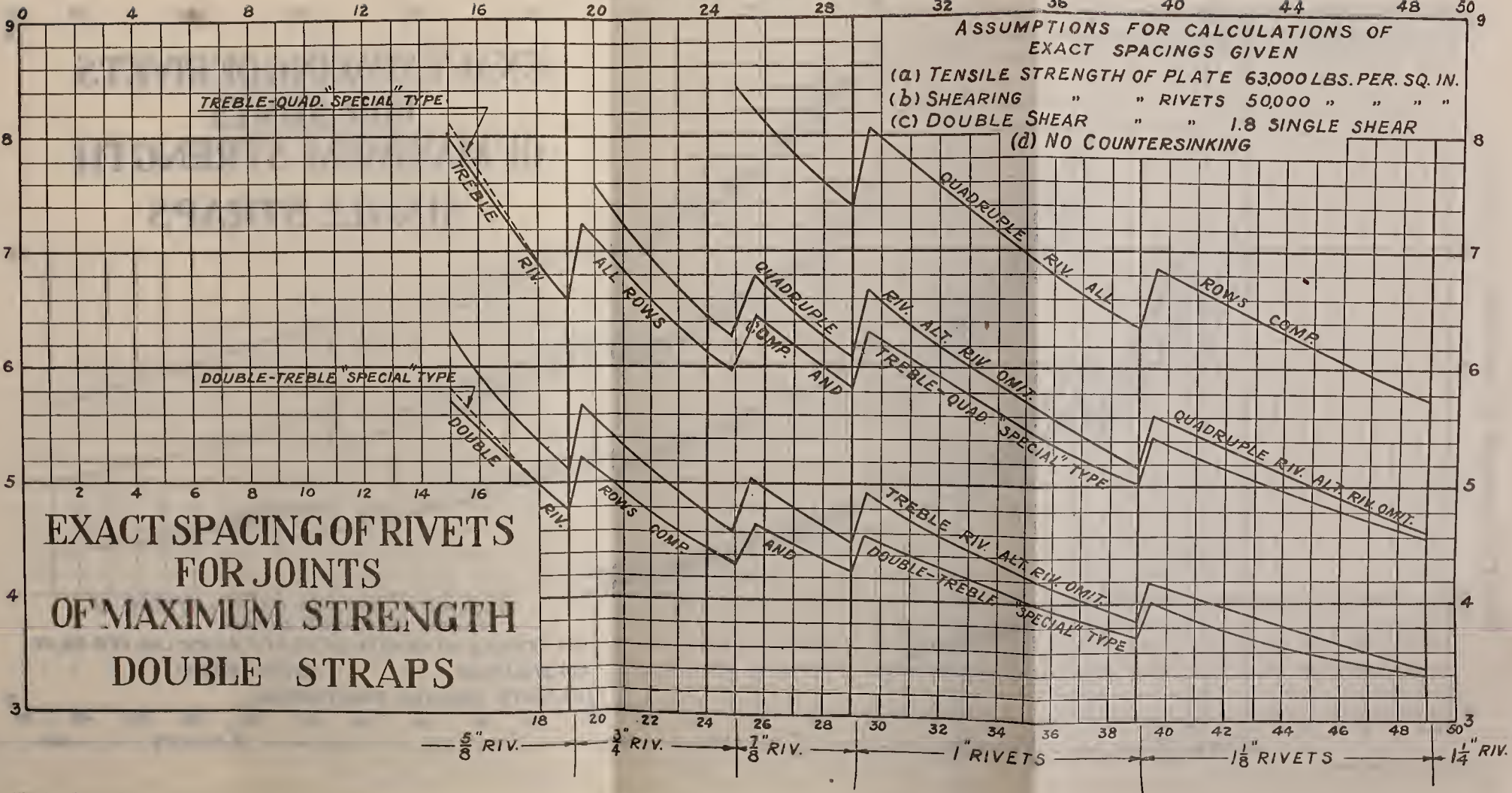
PAN HEADS



NOTE.—The smaller diameter of the head of type P-2 shall be same as corresponding diameter of type P-1.

SCALE OF WEIGHT OF PLATES.

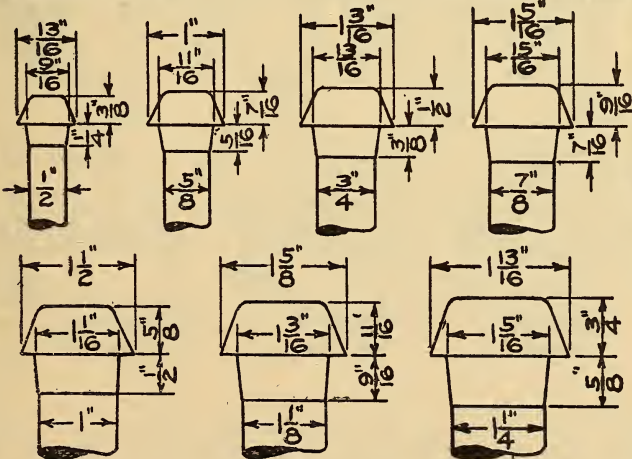
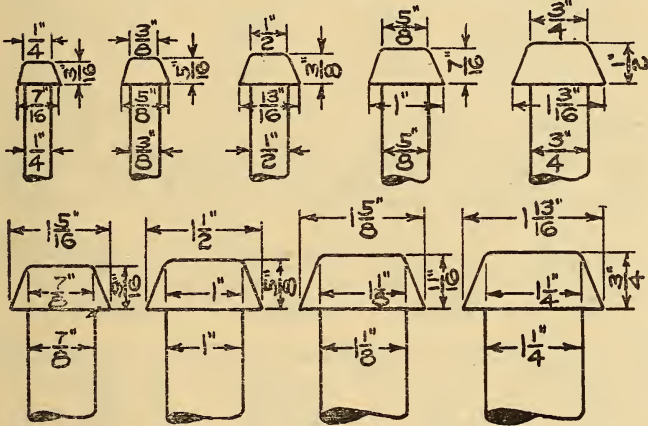
SCALE OF SPACING IN DIAMETERS OF RIVETS.



STANDARD TYPES OF RIVET HEADS AND POINTS.

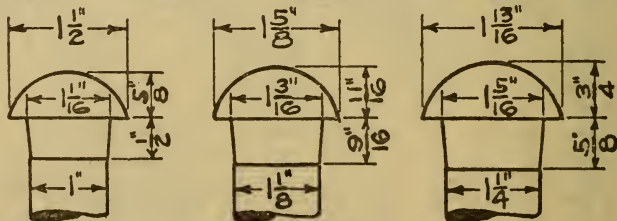
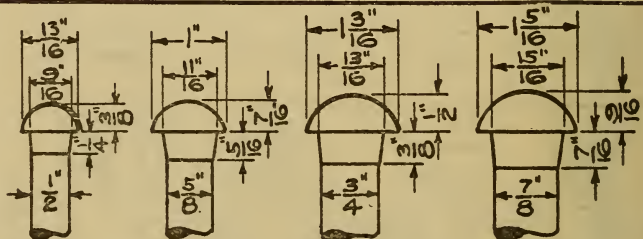
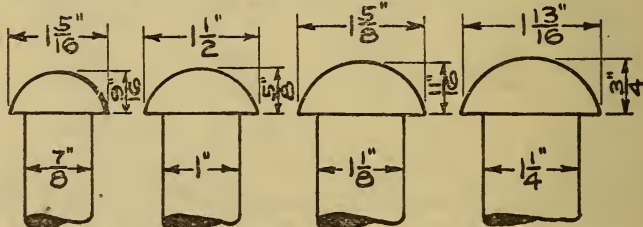
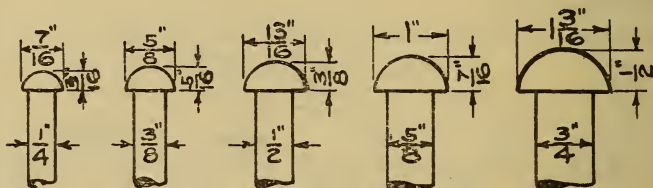
70. The sizes and proportions of standard rivets are illustrated on the following pages:

PAN HEADS

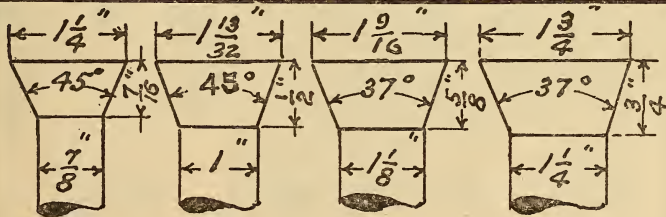
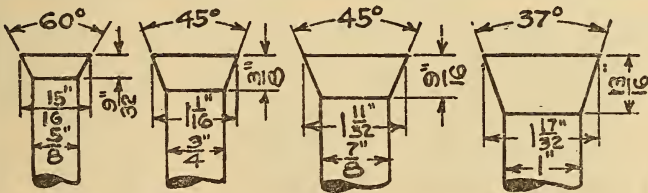
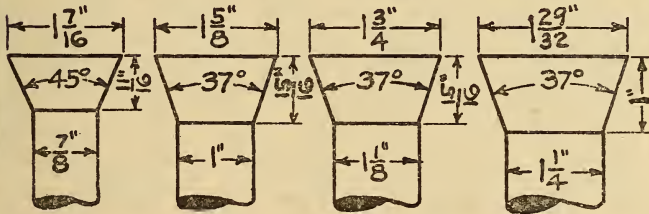
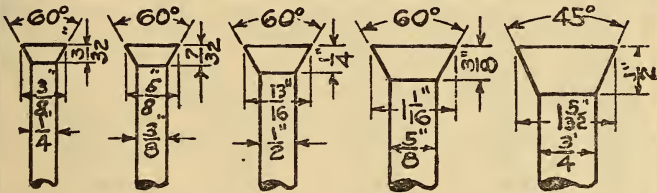


NOTE.—The smaller diameter of the head of type P-2 shall be same as corresponding diameter of type P-1.

BUTTON HEADS

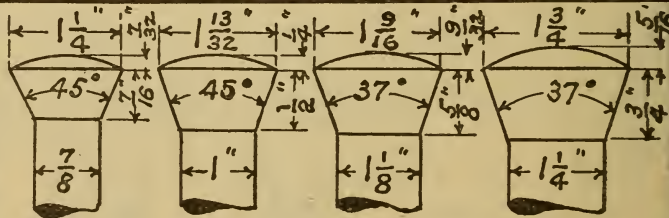
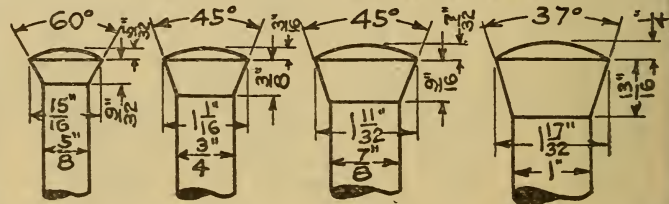
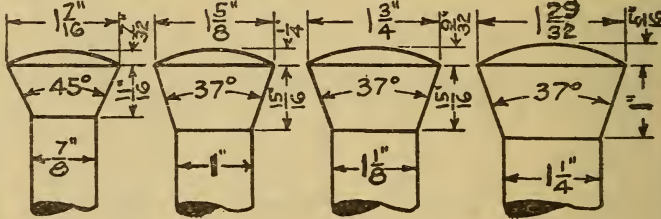
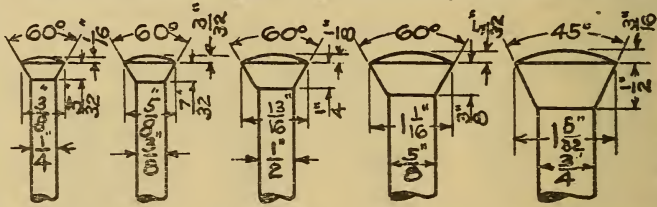


COUNTERSUNK FLAT HEADS



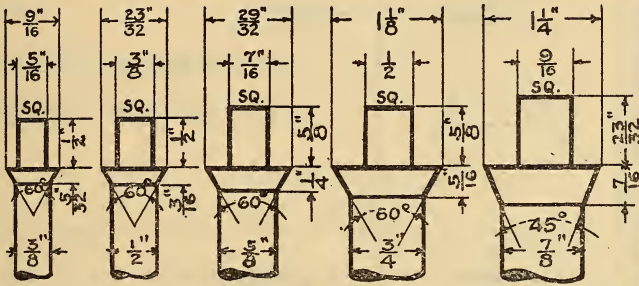
ANGLES AND DEPTHS GIVEN FOR HEADS ARE TO BE FOLLOWED.
DIAMETERS GIVEN FOR HEADS ARE APPROXIMATE ONLY.

COUNTERSUNK RAISED HEADS

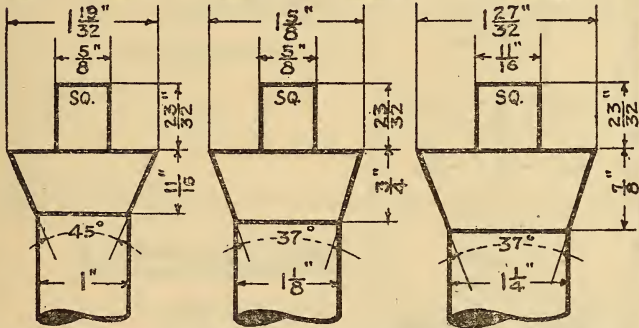


ANGLES AND DEPTHS GIVEN FOR HEADS ARE TO BE FOLLOWED.
DIAMETERS GIVEN FOR HEADS ARE APPROXIMATE ONLY.

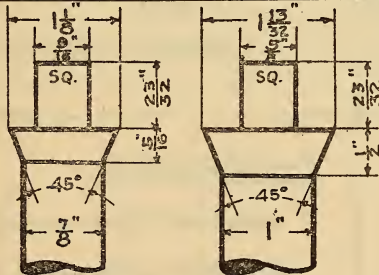
TAPS



T-1



T-1



T-2

T-2

ANGLES AND DEPTHS GIVEN FOR HEADS ARE TO BE FOLLOWED.
DIAMETERS GIVEN FOR HEADS ARE APPROXIMATE ONLY.

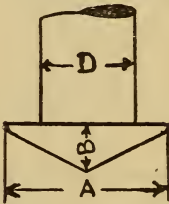
RIVET POINTS

TYPE S

SNAP:

PROPORTIONS SAME AS
FOR BUTTON HEADS

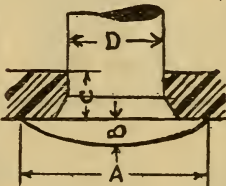
TYPE H

HAMMERED:

$$A = 1 \frac{3}{4} D$$

$$B = \frac{1}{2} D$$

TYPE O

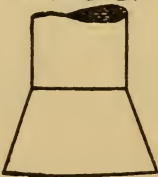
OVAL (LIVERPOOL):

$$A = 2 D$$

$$B = \frac{1}{4} D$$

$$\text{COUNTERSINK} = \frac{1}{2} C$$

TYPE CK

COUNTERSUNK:

PROPORTIONS SAME AS
FOR COUNTERSUNK HEADS

71. SYMBOLS FOR USE IN SCHEDULES, ETC.

TYPES OF RIVETS.

P —Panhead.	CK —Countersunk point.
B —Button head.	S —Snap point.
C —Countersunk head, flat.	H —Hammered point.
CR —Countersunk head, raised.	O —Oval (Liverpool) point.
T —Tap.	

P/CK—Panhead and countersunk point.

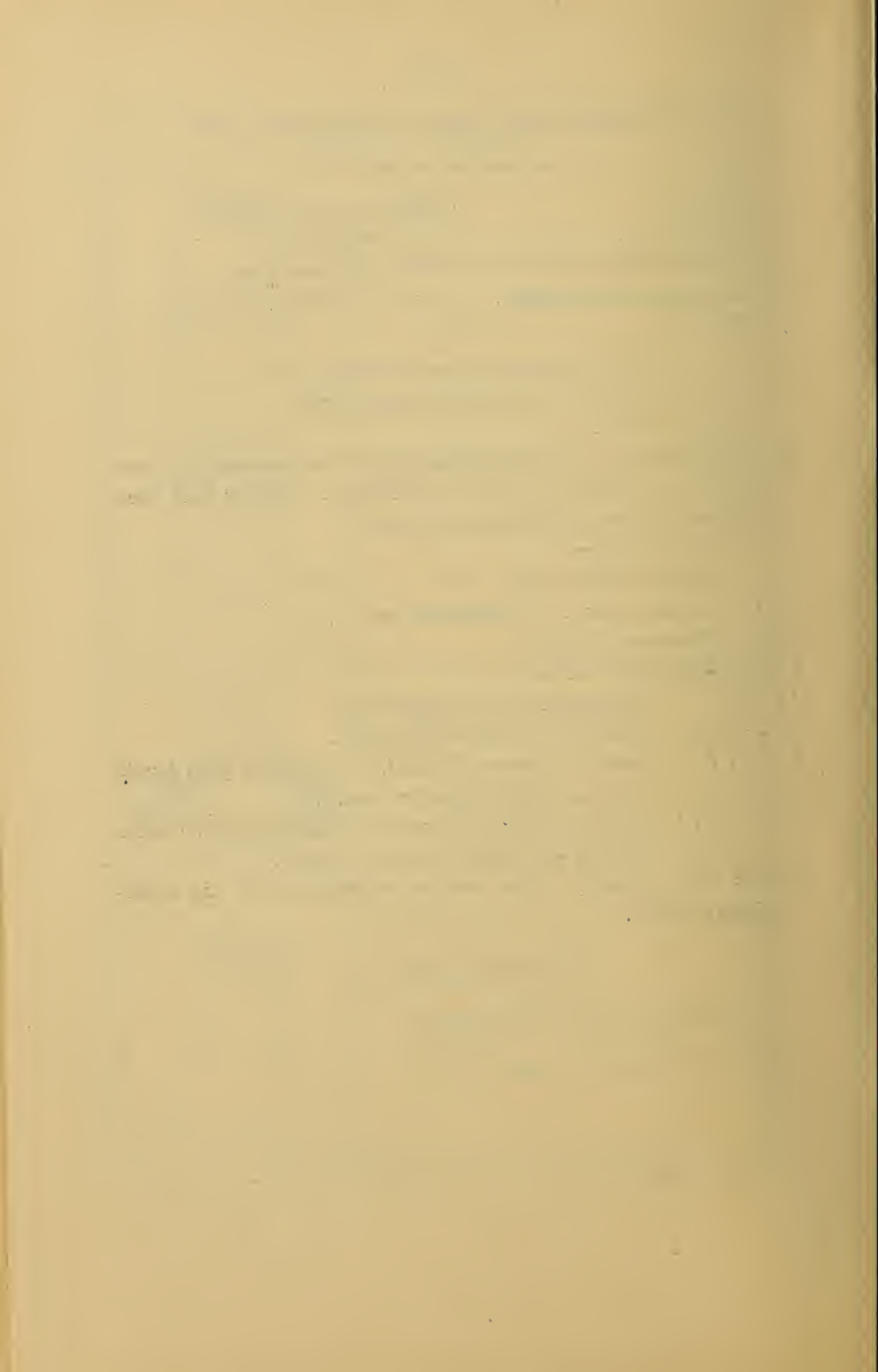
B/S—Button head and snap point.

Etc.

H.—For high-tensile steel rivets. This symbol must precede the dimension for rivet diameter, as **H. 3/4" P/CK**, etc. Medium steel rivets should not have any distinguishing symbol.

/	Single riveting,	} For general use.
//	Double riveting.	
///	Treble riveting,	
////	Quadruple riveting.	
/////	Quintuple riveting.	
// - //	Double butt straps, double riveted.	
/// - ///	Double butt straps, treble riveted.	
// - ///	Double butt straps "Special." The calked strap double and uncalked strap treble riveted.	
/// - ///	Double butt straps "Special." The calked strap treble and uncalked strap quadruple riveted.	

Z.—For zigzag riveting. Chain riveting should not have any distinguishing symbol.



THE FOLLOWING DATA IS FOR REFERENCE ONLY
IN CONNECTION WITH THE PRECEDING
SPECIFICATIONS AND DOES NOT
FORM A PART THEREOF.

72. The widths of chain riveted lap and strap connections, in accordance with the minimum requirements of the riveting specifications, are given in the following tables:

LAPS AND STRAPS.

CHAIN RIVETING.

Weights of plates, nom., in pounds.		Under 3.	From 3 to 7 incl.	Over 7 to 8½ incl.	Over 8½ to 12½ incl.	Widths of con- nections in rivet diamo- ters.
Rivets, inches.....		1/4	3/8	1/2	5/8	
Rivet holes, inches.....		9/32	11/32	9/16	11/16	
Area, holes, sq. in.....		0.062	0.130	0.248	0.371	
Connections.	Riveting.	Widths of connections in inches.				
Seam laps.	I	13/16	1-1/4	1-5/8	2-1/16	3-1/4
	II	1-7/16	2-3/16	2-7/8	3-5/8	5-3/4
Butt laps.	II	1-9/16	2-3/8	3-1/8	3-15/16	6-1/4
	III	.....	.....	4-5/8	5-13/16	9-1/4
Seam and butt straps, single.	I	1-5/8	2-7/16	3-1/4	4-1/16	6-1/2
	II	2-7/8	4-5/16	5-3/4	7-3/16	11-1/2
	III	.....	.....	8-1/4	10-5/16	16-1/2

LAPS AND STRAPS.

CHAIN RIVETING.

Weights of plates, nom., in pounds.		Over 12½ to 19 incl.	Over 19, to 29 incl.	Over 29, to 39 incl.	Over 39, to 49 incl.	Over 49	Widths of con- nections in rivet diami- ters.
Rivets, inches.		3/4	7/8	1	1-1/8	1-1/4	
Rivet holes, inches..		13/16	15/16	1-1/16	1-3/16	1-5/16	
Area, holes, sq. in...		0.518	0.690	0.887	1.107	1.353	
Connections.	Rivet- ing.	Widths of connections in inches.					
Seam laps.	I	2-7/16	2-7/8	3-1/4	3-11/16	4-1/16	3-1/4
	II	4-5/16	5-1/16	5-3/4	6-1/2	7-3/16	5-3/4
	III	6-3/16	7-1/4	8-1/4	9-5/16	10-5/16	8-1/4
Butt laps.	II	4-11/16	5-1/2	6-1/4	7-1/16	7-13/16	6-1/4
	III	6-15/16	8-1/8	9-1/4	10-7/16	11-9/16	9-1/4
	IIII	9-3/16	10-3/4	12-1/4	13-13/16	15-5/16	12-1/4
Seam and butt straps, single.	I	4-7/8	5-11/16	6-1/2	7-5/16	8-1/8	6-1/2
	II	8-5/8	10-1/16	11-1/2	12-15/16	14-3/8	11-1/2
	III	12-3/8	14-7/16	16-1/2	18-9/16	20-5/8	16-1/2
	IIII	16-1/8	18-13/16	21-1/2	24-3/16	26-7/8	21-1/2
	IIIII	19-7/8	23-3/16	26-1/2	29-13/16	33-1/8	26-1/2

73. The widths of zigzag riveted lap and strap connections, in accordance with the minimum requirements of the riveting specifications, are given in the following tables:

LAPS AND STRAPS.

ZIGZAG RIVETING.

Weights of plates, nom., in pounds.		Under 3.	From 3 to 7 incl.	Over 7 to 8½ incl.	Widths of connections in rivet diameters.
Rivets, inches.....		1/4	3/8	1/2	
Rivet holes, inches.....		9/32	1 1/32	9/16	
Area, holes, sq. in.....		0.062	0.130	0.248	
Connections.	Spacing in each row.	Width of connections in inches.			
Seam laps..//	3-1/2 rivet diameters..	1-3/16	1-13/16	2-3/8	4-3/4
	4 rivet diameters.....	1-1/4	1-7/8	2-1/2	5
	4-1/2 rivet diameters..	1-9/32	1-15/16	2-9/16	5-1/8
Single straps..//	3-1/2 rivet diameters..	2-3/8	3-9/16	4-3/4	9-1/2
	4 rivet diameters.....	2-1/2	3-3/4	5	10
	4-1/2 rivet diameters..	2-9/16	3-7/8	5-1/8	10-1/4

LAPS AND STRAPS.

ZIGZAG RIVETING

Weights of plates, nom. in pounds.		Over 8½ to 12½ incl.	Over 12½ to 19 incl.	Over 19 to 29 incl.	Widths of connections in rivet diameters.
Rivets, inches.....		5/8	3/4	7/8	
Rivet holes, inches.....		11/16	13/16	15/16	
Area, holes, sq. in.....		0.371	0.518	0.69	
Connections.	Spacing in each row.	Width of connections in inches.			
Seam laps...//	3-1/2 rivet diameters..	3	3-9/16	4-3/4	4-3/4
	4 rivet diameters.....	3-1/8	3-3	4-3/8	5
	4-1/2 rivet diameters..	3-1/4	3-7/8	4-1/2	5-1/8
Single straps...//	3-1/2 rivet diameters..	5-15/16	7-1/8	8-5/16	9-1/2
	4 rivet diameters.....	6-1/4	7-1/2	8-3/4	10
	4-1/2 rivet diameters..	6-7/16	7-11/16	9	10-1/4

74. The widths of chain riveted double butt straps, in accordance with the minimum requirements of the riveting specifications, are given in the following table:

DOUBLE BUTT STRAPS.

CHAIN RIVETING.

Weights of plates, nom. in pounds.	Over 12½ to 19 incl.	Over 19 to 25 incl.	Over 25 to 29 incl.	Over 29 to 39 incl.	Over 39 to 49 incl.	Over 49.	Widths of straps in rivet diameter. ters.
Rivets, inches....	5/8	3/4	7/8	1	1-1/8	1-1/4	
Holes, inches.....	11/16	13/16	15/16	1-1/16	1-3/16	1-5/16	
Area, holes, sq. in.	0. 371	0. 518	0. 690	0. 887	1. 107	1. 353	
Riveting.	Widths of straps, in inches.						
<i>II-II</i>	7-13/16	9-3/8	10-15/16	12-1/2	14-1/16	15-5/8	12-1/2
<i>III-III</i>	11-9/16	13-7/8	16-3/16	18-1/2	20-13/16	23-1/8	18-1/2
<i>IIII-IIII</i>	15-5/16	18-3/8	21-7/16	24-1/2	27-9/16	30-5/8	24-1/2

75. The following table gives transverse locations for rivets in flanges of single riveted shapes:

GAGE TABLE FOR SHAPES—SINGLE RIVETING.

Diameter of rivets.	Width of flange: sum of dimen- sions A, B, and C.	A.	B.	C.	Minimum distance from edge of un- planed shape, 1-5/8 diameters of rivet.
		Thick- ness of flange.	Distance from in- side of vertical flange.	Distance from edge of shape.	
			To center of rivets.		
Inches.					
1/4	1 1-1/4	1/8 1/8	7/16 9/16	7/16 9/16	7/16
3/8	1-1/2 1-3/4	3/16 3/16	11/16 13/16	5/8 3/4	5/8
1/2	2 2-1/4	3/16 3/16	15/16 1-1/16	7/8 1	13/16
5/8	2-1/2 3	1/4 5/16	1-1/8 1-5/16	1-1/8 1-3/8	1
3/4	3 3-1/2 4	5/16 5/16 3/8	1-5/16 1-9/16 1-3/4	1-3/8 1-5/8 1-7/8	1-1/4
7/8	3-1/2 4	3/8 3/8	1-9/16 1-3/4	1-9/16 1-7/8	1-7/16
1	4	7/16	1-3/4	1-13/16	1-5/8
1-1/8	5	3/8	2-3/8	2-1/4	1-13/16
1-1/4	5	7/16	2-3/8	2-3/16	2-1/16

76. The following table gives transverse spacings for rivets in shapes, with the corresponding net widths of flanges, for the longitudinal spacings of rivets and thicknesses of bars noted:

GAGE TABLE FOR SHAPES, ZIGZAG RIVETING.

Diameter of rivets.	Spacing of rivets.		A.	B.	C.	D.	Minimum width of unplanned flange required:
	In rows.	Between rows.	Thick-ness of flange.	Distance from inside of vertical flange to first row.	Between rows.	Distance from second row to edge, at 1-5/8 diameters.	Sum of dimensions A, B, C, and D.
	To center of rivet.						
Inches.	Rivet diameters.		Inches.				
3/8	4 4-1/2 5-1/2	1-3/4 1-7/8 2	1/4	3/4	11/16 11/16 3/4	5/8	2-5/16 2-5/16 2-3/8
1/2	4 4-1/2 5-1/2	1-3/4 1-7/8 2	5/16	7/8	7/8 15/16 1	13/16	2-7/8 2-15/16 3
5/8	4 4-1/2 5-1/2	1-3/4 1-7/8 2	5/16	1	1-1/8 1-3/16 1-1/4	1	3-7/16 3-1/2 3-9/16
3/4	4 4-1/2 5-1/2	1-3/4 1-7/8 2	5/16	1-1/8	1-5/16 1-7/16 1-1/2	1-1/4	4 4-1/8 4-3/16
7/8	4 4-1/2 5-1/2	1-3/4 1-7/8 2	3/8	1-5/16	1-9/16 1-5/8 1-3/4	1-7/16	4-11/16 4-3/4 4-7/8
1	4 4-1/2 5-1/2	1-3/4 1-7/8 2	1/2	1-1/2	1-3/4 1-7/8 2	1-5/8	5-3/8 5-1/2 5-5/8
1-1/8	4 4-1/2 5-1/2	1-3/4 1-7/8 2	1/2	1-5/8	2 2-1/8 2-1/4	1-13/16	5-15/16 6-1/16 6-3/16
1-1/4	4 4-1/2 5-1/2	1-3/4 1-7/8 2	5/8	1-3/4	2-3/16 2-3/8 2-1/2	2-1/16	6-5/8 6-13/16 6-15/16

Distance "B," in table, for 3/8-inch rivets is taken as 2 diameters, for 3/4 to 1 inch rivets inclusive as 1-1/2 diameters, and for 1-1/4-inch rivets as 1-4/10 diameters. For other rivets the distances are graduated between those mentioned.

LENGTHS OF RIVETS FOR ORDERING.

77. The length for ordering pan and button head rivets is measured exclusive of the head; for countersunk rivets and taps the ordered length includes the head to the top of the countersink.

ALLOWANCE FOR POINTS IN LENGTH OF RIVETS, WITH TWO THICKNESSES CONNECTED.

Type of point.	Diameter of rivets (inches).					
	1/2	5/8	3/4	7/8	1	1-1/8
Countersunk----	1/2	5/8	3/4	7/8	1	1-1/8
Hammered-----	1/2	1/2	1/2	5/8	5/8	5/8
Snap-----	7/8	1	1-1/8	1-1/4	1-3/8	1-1/2
Oval-----	7/8	7/8	-----	-----	-----	-----

For each additional thickness 1/8 inch should be added.

Allowances given are approximate only and are based upon the average practice at various navy yards and private ship yards. Where sufficient data at a particular yard is available, such data should be used in preference to that contained in the table.

TABLE FOR OBTAINING WEIGHT IN POUNDS OF 100 RIVETS.

78. To obtain the weight of 100 rivets of any size or type given in the specifications: Multiply the ordered length as defined in paragraph 77, expressed in eighths of an inch, by the weights given in column W. Add to this the weight as given in columns P. 1 to CR. 3, according to the type of rivet considered. In the case of tap rivets the same procedure is to be followed, using column X for length weights and columns T. 1, or T. 2, as applicable.

Diam-eter of rivet (inches).	Weight to be added to cylindrical part of 100 rivets.												Weight to be added to cylindrical part of 100 rivets.*	Weight to be added to ordered length of 100 rivets for ordered length.	Diam-eter of rivet (inches).
	Type of rivet.														
	P. 1.	P. 2.	B. 1.	B. 2.	C. 1.	C. 2.	C. 3.	CR. 1.	CR. 2.	CR. 3.	W.	T. 1.				T. 2.	X.
1/4	0.51	.....	0.50	.....	0.076	.....	.....	0.100	.....	.....	0.174	.....	.....	.....	1/2
3/8	1.55	.....	1.55	.....	0.558	.....	.....	0.713	.....	.....	.391	.....	.....	.....
1/2	3.66	3.75	3.54	3.63	1.05	.....	.....	2.18	.....	.....	.696	2.70	.....	0.571	5/8
5/8	6.55	6.84	6.12	6.41	2.82	1.43	.....	5.37	3.22	.....	1.087	4.89	.....	0.902	
3/4	10.62	11.03	9.71	10.12	4.01	2.23	.....	7.51	4.96	.....	1.566	7.33	.....	1.32	7/8
7/8	15.19	15.74	13.43	13.99	9.15	6.06	.....	15.95	11.53	8.03	2.131	11.23	.....	1.81	
1	22.03	22.76	19.28	20.00	15.77	11.32	5.14	26.07	19.78	11.49	2.784	21.14	8.92	2.37	1
1-1/8	29.27	30.19	25.04	25.95	17.40	.....	7.74	30.04	.....	16.60	3.523	21.94	15.21	2.99	1-1/8
1-1/4	39.60	40.73	33.70	34.82	21.46	.....	11.83	37.77	.....	24.33	4.350	30.53	.....	3.76	1-1/4

* In obtaining weights allowances have been made for material cut out by threads.

NOTE.—1. The weights are calculated using 0.28356 pounds per cubic inch and were checked in certain cases with the actual weights of rivets and found to reasonably agree.

2. The values in the columns, exclusive of W and X, are the weights of that part of the head, neck, and stud on taps, of the various types of rivets which is outside or above the cylindrical part. The cylindrical part is assumed to extend the full ordered length, as defined in paragraph 77.

Example: To find weight of 100, 7/8-inch, pan-head rivets, 2 inches long, coned under head:
Length as per rule 2''=16 eighths.

Weight of cylindrical part as per column W=2.131×16.....	Pounds. 34.096
Weight to be added from column P. 2.....	15.74

The required weight is 49.836

Example: To find the weight of 100, 1-inch tap rivets, type T. 1, 2 1/2 inches long:
Length as per rule 2 1/2''=20 eighths.

Weight of cylindrical threaded part as per column X.....	Pounds. 47.40
Weight to be added from column T, 1.....	21.14

The required weight is 68.54

79. The values of rivet diameters reduced to inches, are given in the following tables:

Number of dia n- eters.	Diameter of rivets (inches).								
	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
1-1/2	3/8	9/16	3/4	15/16	1-1/8	1-5/16	1-1/2	1-11/16	1-7/8
1-5/8	7/16	5/8	13/16	1	1-1/4	1-7/16	1-5/8	1-13/16	2-1/16
1-3/4	7/16	11/16	7/8	1-1/8	1-5/16	1-9/16	1-3/4	2	2-3/16
1-7/8	1/2	11/16	15/16	1-3/16	1-7/16	1-5/8	1-7/8	2-1/8	2-3/8
2	1/2	3/4	1	1-1/4	1-1/2	1-3/4	2	2-1/4	2-1/2
2-1/4	9/16	7/8	1-1/8	1-7/16	1-11/16	2	2-1/4	2-9/16	2-13/16
2-1/2	5/8	15/16	1-1/4	1-9/16	1-7/8	2-3/16	2-1/2	2-13/16	3-1/8
2-3/4	11/16	1-1/16	1-3/8	1-3/4	2-1/16	2-7/16	2-3/4	3-1/8	3-7/16
3	3/4	1-1/8	1-1/2	1-7/8	2-1/4	2-5/8	3	3-3/8	3-3/4
3-1/4	13/16	1-1/4	1-5/8	2-1/16	2-7/16	2-7/8	3-1/4	3-11/16	4-1/16
3-1/2	7/8	1-5/16	1-3/4	2-3/16	2-5/8	3-1/16	3-1/2	3-15/16	4-3/8
3-3/4	15/16	1-7/16	1-7/8	2-3/8	2-13/16	3-5/16	3-3/4	4-1/4	4-11/16
4	1	1-1/2	2	2-1/2	3	3-1/2	4	4-1/2	5
4-1/4	1-1/16	1-5/8	2-1/8	2-11/16	3-3/16	3-3/4	4-1/4	4-13/16	5-5/16
4-1/2	1-1/8	1-11/16	2-1/4	2-13/16	3-3/8	3-15/16	4-1/2	5-1/16	5-5/8
4-3/4	1-3/16	1-13/16	2-3/8	3	3-9/16	4-3/16	4-3/4	5-3/8	5-15/16
5	1-1/4	1-7/8	2-1/2	3-1/8	3-3/4	4-3/8	5	5-5/8	6-1/4
5-1/4	1-5/16	2	2-5/8	3-5/16	3-15/16	4-5/8	5-1/4	5-15/16	6-9/16
5-1/2	1-3/8	2-1/16	2-3/4	3-7/16	4-1/8	4-13/16	5-1/2	6-3/16	6-7/8
5-3/4	1-7/16	2-3/16	2-7/8	3-5/8	4-5/16	5-1/16	5-3/4	6-1/2	7-3/16
6	1-1/2	2-1/4	3	3-3/4	4-1/2	5-1/4	6	6-3/4	7-1/2
6-1/4	1-9/16	2-3/8	3-1/8	3-15/16	4-11/16	5-1/2	6-1/4	7-1/16	7-13/16
6-1/2	1-5/8	2-7/16	3-1/4	4-1/16	4-7/8	5-11/16	6-1/2	7-5/16	8-1/8
6-3/4	1-11/16	2-9/16	3-3/8	4-1/4	5-1/16	5-15/16	6-3/4	7-5/8	8-7/16

Number of diameters.	Diameter of rivets (inches).								
	1/4	3/8	1/2	5/8	3/4	7/8	1	1-1/8	1-1/4
7	1-3/4	2-5/8	3-1/2	4-3/8	5-1/4	6-1/8	7	7-7/8	8-3/4
7-1/4	1-13/16	2-3/4	3-5/8	4-9/16	5-7/16	6-3/8	7-1/4	8-3/16	9-1/16
7-1/2	1-7/8	2-13/16	3-3/4	4-11/16	5-5/8	6-9/16	7-1/2	8-7/16	9-3/8
7-3/4	1-15/16	2-15/16	3-7/8	4-7/8	5-13/16	6-13/16	7-3/4	8-3/4	9-11/16
8	2	3	4	5	6	7	8	9	10
8-1/4	2-1/16	3-1/8	4-1/8	5-3/16	6-3/16	7-1/4	8-1/4	9-5/16	10-5/16
8-1/2	2-1/8	3-3/16	4-1/4	5-5/16	6-3/8	7-7/16	8-1/2	9-9/16	10-5/8
8-3/4	2-3/16	3-5/16	4-3/8	5-1/2	6-9/16	7-11/16	8-3/4	9-7/8	10-15/16
9	2-1/4	3-3/8	4-1/2	5-5/8	6-3/4	7-7/8	9	10-1/8	11-1/4
9-1/4	2-5/16	3-1/2	4-5/8	5-13/16	6-15/16	8-1/8	9-1/4	10-7/16	11-9/16
9-1/2	2-3/8	3-9/16	4-3/4	5-15/16	7-1/8	8-5/16	9-1/2	10-11/16	11-7/8
9-3/4	2-7/16	3-11/16	4-7/8	6-1/8	7-5/16	8-9/16	9-3/4	11	12-3/16
10	2-1/2	3-3/4	5	6-1/4	7-1/2	8-3/4	10	11-1/4	12-1/2
10-1/4	2-9/16	3-7/8	5-1/8	6-7/16	7-11/16	9	10-1/4	11-9/16	12-13/16
10-1/2	2-5/8	3-15/16	5-1/4	6-9/16	7-7/8	9-3/16	10-1/2	11-13/16	13-1/8
10-3/4	2-11/16	4-1/16	5-3/8	6-3/4	8-1/16	9-7/16	10-3/4	12-1/8	13-7/16
11	2-3/4	4-1/8	5-1/2	6-7/8	8-1/4	9-5/8	11	12-3/8	13-3/4
11-1/4	2-13/16	4-1/4	5-5/8	7-1/16	8-7/16	9-7/8	11-1/4	12-11/16	14-1/16
11-1/2	2-7/8	4-5/16	5-3/4	7-3/16	8-5/8	10-1/16	11-1/2	12-15/16	14-3/8
11-3/4	2-15/16	4-7/16	5-7/8	7-3/8	8-13/16	10-5/16	11-3/4	13-1/4	14-11/16
12	3	4-1/2	6	7-1/2	9	10-1/2	12	13-1/2	15
12-1/4	3-1/16	4-5/8	6-1/8	7-11/16	9-3/16	10-3/4	12-1/4	13-13/16	15-5/16
12-1/2	3-1/8	4-11/16	6-1/4	7-13/16	9-3/8	10-15/16	12-1/2	14-1/16	15-5/8

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			Distance between end rivets (inches).										Diameter of rivet (inches).
			1	2	3	4	5	6	7	8	9	10	
6	Spacing of rivets.	Ins.	$\frac{3}{16}$	$\frac{13}{32}$	$\frac{19}{32}$	$\frac{13}{16}$	1	$1\frac{3}{16}$	$1\frac{13}{32}$	$1\frac{19}{32}$	$1\frac{13}{16}$	2	
		Diameters.	-----	-----	-----	-----	-----	-----	-----	3.2	3.6	4.0	1/2
			0.3	0.7	0.9	1.3	1.6	1.9	2.3	2.6	2.9	3.2	5/8
			.3	.5	.8	1.1	1.3	1.6	1.9	2.1	2.4	2.7	3/4
			.2	.5	.7	.9	1.1	1.4	1.6	1.8	2.1	2.3	7/8
			.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	1
			.2	.4	.5	.7	.9	1.1	1.3	1.4	1.6	1.8	1-1/8
7	Spacing of rivets.	Ins.	$\frac{5}{32}$	$\frac{11}{32}$	$\frac{1}{2}$	$\frac{21}{32}$	$\frac{27}{32}$	1	$1\frac{5}{32}$	$1\frac{11}{32}$	$1\frac{1}{2}$	$1\frac{21}{32}$	
		Diameters.	0.3	0.7	1.0	1.3	1.7	2.0	2.3	2.7	3.0	3.3	1/2
			.3	.6	.8	1.1	1.4	1.6	1.9	2.2	2.4	2.7	5/8
			.2	.5	.7	.9	1.1	1.3	1.5	1.8	2.0	2.2	3/4
			.2	.4	.6	.8	1.0	1.1	1.3	1.5	1.7	1.9	7/8
			.2	.3	.5	.6	.8	1.0	1.2	1.3	1.5	1.6	1
			.1	.3	.4	.6	.8	.9	1.0	1.2	1.3	1.5	1 1/8
8	Spacing of rivets.	Ins.	$\frac{5}{32}$	$\frac{9}{32}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{23}{32}$	$\frac{27}{32}$	1	$1\frac{5}{32}$	$1\frac{9}{32}$	$1\frac{7}{16}$	
		Diameters.	0.3	0.6	0.9	1.1	1.4	1.7	2.0	2.3	2.6	2.9	1/2
			.3	.5	.7	.9	1.2	1.4	1.6	1.9	2.1	2.3	5/8
			.2	.4	.6	.8	1.0	1.1	1.3	1.5	1.7	1.9	3/4
			.2	.3	.5	.6	.8	1.0	1.1	1.3	1.5	1.6	7/8
			.2	.3	.4	.6	.7	.8	1.0	1.2	1.3	1.4	1
			.1	.3	.4	.5	.6	.8	.9	1.0	1.1	1.3	1-1/8

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			Distance between end rivets (inches).								Diameter of rivet (inches)	
			20	30	40	50	60	70	80	90		100
6	Spacing of rivets.	Ins.	4	6	8	10	12	14	16	18	20	
		Diameters.	8.0	12.0	.....	.....	.....	.....	.....	.....	.....	1/2
			6.4	9.6	.....	.....	.....	.....	.....	.....	.....	5/8
			5.3	8.0	10.7	.....	.....	.....	.....	.....	.....	3/4
			4.6	6.9	9.1	.....	.....	.....	.....	.....	.....	7/8
			4.0	6.0	8.0	10.0	.....	.....	.....	.....	.....	1
			3.6	5.3	7.1	8.9	.....	.....	.....	.....	.....	1-1/8
7	Spacing of rivets.	Ins.	3 $\frac{1}{2}$	5	6 $\frac{1}{2}$	8 $\frac{1}{2}$	10	11 $\frac{1}{2}$	13 $\frac{1}{2}$	15	16 $\frac{1}{2}$	
		Diameters.	6.7	10.0	.....	.....	.....	.....	.....	.....	.....	1/2
			5.4	8.0	10.7	.....	.....	.....	.....	.....	.....	5/8
			4.5	6.7	8.9	.....	.....	.....	.....	.....	.....	3/4
			3.8	5.7	7.6	9.5	.....	.....	.....	.....	.....	7/8
			3.3	5.0	6.7	8.3	.....	.....	.....	.....	.....	1
			3.0	4.4	5.9	7.4	8.9	.....	.....	.....	.....	1-1/8
8	Spacing of rivets.	Ins.	2 $\frac{7}{8}$	4 $\frac{3}{4}$	5 $\frac{3}{4}$	7 $\frac{5}{8}$	8 $\frac{9}{16}$	10	11 $\frac{7}{16}$	12 $\frac{27}{32}$	14 $\frac{9}{32}$	
		Diameters.	5.7	8.6	.....	.....	.....	.....	.....	.....	.....	1/2
			4.6	6.9	9.2	.....	.....	.....	.....	.....	.....	5/8
			3.8	5.7	7.6	9.5	.....	.....	.....	.....	.....	3/4
			3.3	4.9	6.5	8.2	.....	.....	.....	.....	.....	7/8
			2.8	4.3	5.7	7.2	8.6	.....	.....	.....	.....	1
			2.5	3.8	5.1	6.4	7.6	8.9	.....	.....	.....	1-1/8

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			• Distance between end rivets (inches).										Diameter of rivet (inches)
			1	2	3	4	5	6	7	8	9	10	
		Ins.	$\frac{1}{8}$	$\frac{1}{4}$	$\frac{3}{8}$	$\frac{1}{2}$	$\frac{5}{8}$	$\frac{3}{4}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	$1\frac{1}{4}$	
9	Spacing of rivets.	Diameters.	0.3	0.5	0.8	1.0	1.3	1.5	1.8	2.0	2.3	2.5	1/2
			.2	.4	.6	.8	1.0	1.2	1.4	1.6	1.8	2.0	5/8
			.2	.3	.5	.7	.8	1.0	1.2	1.3	1.5	1.7	3/4
			.1	.3	.4	.6	.7	.9	1.0	1.1	1.3	1.4	7/8
			.1	.3	.4	.5	.6	.8	.9	1.0	1.1	1.3	1
			.1	.2	.3	.4	.6	.7	.8	.9	1.0	1.1	1-1/8
10	Spacing of rivets.	Diameters.	$\frac{1}{8}$	$\frac{7}{32}$	$\frac{11}{32}$	$\frac{7}{16}$	$\frac{9}{16}$	$\frac{21}{32}$	$\frac{25}{32}$	$\frac{7}{8}$	1	$1\frac{1}{8}$	
			0.3	0.4	0.7	0.9	1.1	1.3	1.6	1.8	2.0	2.3	1/2
			.2	.4	.6	.7	.9	1.1	1.3	1.4	1.6	1.8	5/8
			.2	.3	.5	.6	.8	.9	1.0	1.2	1.3	1.5	3/4
			.1	.3	.4	.5	.6	.8	.9	1.0	1.1	1.3	7/8
			.1	.2	.3	.4	.6	.7	.8	.9	1.0	1.2	1
			.1	.2	.3	.4	.5	.6	.7	.8	.9	1.0	1-1/8
11	Spacing of rivets.	Diameters.	$\frac{3}{32}$	$\frac{13}{64}$	$\frac{19}{64}$	$\frac{13}{32}$	$\frac{1}{2}$	$\frac{19}{32}$	$\frac{45}{64}$	$\frac{51}{64}$	$\frac{29}{32}$	1	
			0.20	0.40	0.60	0.80	1.00	1.20	1.40	1.60	1.80	2.00	1/2
			.16	.32	.48	.64	.80	.96	1.12	1.28	1.44	1.60	5/8
			.13	.27	.40	.53	.67	.80	.93	1.07	1.20	1.33	3/4
			.11	.23	.34	.46	.57	.69	.80	.91	1.03	1.14	7/8
			.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	1
			.09	.18	.27	.36	.44	.53	.62	.71	.80	.89	1-1/8

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			Distance between end rivets (inches).										Diameter of rivet (inches)
			1	2	3	4	5	6	7	8	9	10	
12	Spacing of rivets.	Ins.	$\frac{3}{32}$	$\frac{3}{16}$	$\frac{17}{64}$	$\frac{23}{64}$	$\frac{29}{64}$	$\frac{35}{64}$	$\frac{41}{64}$	$\frac{47}{64}$	$\frac{13}{16}$	$\frac{29}{32}$	
		Diameters.	0.18	0.36	0.54	0.72	0.91	1.09	1.27	1.46	1.64	1.82	1/2
			.15	.29	.44	.58	.73	.88	1.02	1.17	1.31	1.46	5/8
			.12	.24	.36	.48	.60	.73	.85	.97	1.09	1.21	3/4
			.10	.21	.31	.41	.52	.62	.73	.83	.94	1.04	7/8
			.09	.18	.27	.36	.45	.55	.64	.73	.82	.91	1
			.08	.16	.24	.32	.40	.49	.57	.65	.73	.81	1-1/8
13	Spacing of rivets.	Ins.	$\frac{5}{64}$	$\frac{11}{64}$	$\frac{1}{4}$	$\frac{21}{64}$	$\frac{27}{64}$	$\frac{1}{2}$	$\frac{37}{64}$	$\frac{43}{64}$	$\frac{3}{4}$	$\frac{53}{64}$	
		Diameters.	0.17	0.33	0.50	0.67	0.83	1.00	1.17	1.33	1.50	1.67	1/2
			.14	.27	.40	.54	.67	.80	.94	1.07	1.20	1.34	5/8
			.11	.22	.33	.45	.56	.67	.78	.89	1.00	1.11	3/4
			.09	.19	.29	.38	.47	.57	.67	.76	.86	.95	7/8
			.08	.16	.25	.34	.42	.50	.58	.66	.75	.83	1
			.07	.15	.22	.30	.37	.44	.52	.59	.67	.74	1-1/8
14	Spacing of rivets.		$\frac{5}{64}$	$\frac{5}{32}$	$\frac{15}{64}$	$\frac{5}{16}$	$\frac{25}{64}$	$\frac{15}{32}$	$\frac{17}{32}$	$\frac{39}{64}$	$\frac{11}{16}$	$\frac{59}{64}$	
		Diameters.	0.16	0.31	0.46	0.61	0.77	0.93	1.08	1.23	1.39	1.54	1/2
			.13	.25	.37	.49	.62	.74	.86	.99	1.11	1.23	5/8
			.10	.20	.30	.41	.51	.62	.72	.82	.93	1.03	3/4
			.09	.17	.26	.35	.44	.53	.61	.70	.79	.88	7/8
			.08	.15	.23	.31	.38	.46	.54	.62	.69	.77	1
			.07	.14	.21	.27	.34	.41	.48	.55	.62	.68	1-1/8

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			Distance between end rivets (inches).										Diameter of rivet (inches)
			1	2	3	4	5	6	7	8	9	10	
15	Spacing of rivets.	Ins.	$\frac{5}{64}$	$\frac{9}{64}$	$\frac{7}{32}$	$\frac{9}{32}$	$\frac{23}{64}$	$\frac{27}{64}$	$\frac{1}{2}$	$\frac{37}{64}$	$\frac{41}{64}$	$\frac{23}{32}$	
			0.14	0.29	0.43	0.57	0.71	0.86	1.00	1.14	1.29	1.43	1/2
			.12	.23	.34	.46	.57	.69	.80	.92	1.03	1.15	5/8
			.10	.19	.28	.38	.48	.57	.67	.76	.86	.95	3/4
			.08	.16	.24	.32	.41	.49	.57	.65	.74	.82	7/8
			.07	.14	.21	.28	.36	.43	.50	.57	.64	.72	1
			.06	.13	.19	.25	.32	.38	.44	.51	.57	.64	1-1/8
16	Spacing of rivets.	Ins.	$\frac{1}{16}$	$\frac{9}{64}$	$\frac{13}{64}$	$\frac{17}{64}$	$\frac{21}{64}$	$\frac{13}{32}$	$\frac{15}{32}$	$\frac{17}{32}$	$\frac{19}{32}$	$\frac{43}{64}$	
			0.13	0.27	0.40	0.53	0.67	0.80	0.93	1.07	1.20	1.33	1/2
			.11	.22	.32	.43	.53	.64	.75	.86	.96	1.07	5/8
			.09	.18	.27	.35	.45	.53	.62	.71	.80	.89	3/4
			.08	.15	.23	.30	.38	.46	.53	.61	.69	.76	7/8
			.07	.13	.20	.27	.33	.40	.47	.53	.60	.67	1
			.06	.12	.18	.24	.30	.36	.41	.48	.53	.59	1-1/8
17	Spacing of rivets.	Ins.	$\frac{1}{16}$	$\frac{1}{8}$	$\frac{3}{16}$	$\frac{1}{4}$	$\frac{5}{16}$	$\frac{3}{8}$	$\frac{7}{16}$	$\frac{1}{2}$	$\frac{9}{16}$	$\frac{5}{8}$	
			0.13	0.25	0.38	0.50	0.63	0.75	0.88	1.00	1.13	1.25	1/2
			.10	.20	.30	.40	.50	.60	.70	.80	.90	1.00	5/8
			.08	.17	.25	.33	.42	.50	.58	.67	.75	.83	3/4
			.07	.14	.21	.29	.36	.43	.50	.57	.64	.71	7/8
			.06	.13	.19	.25	.31	.38	.44	.50	.56	.63	1
			.05	.11	.17	.22	.28	.33	.39	.44	.50	.56	1-1/8

SPACING TABLE.

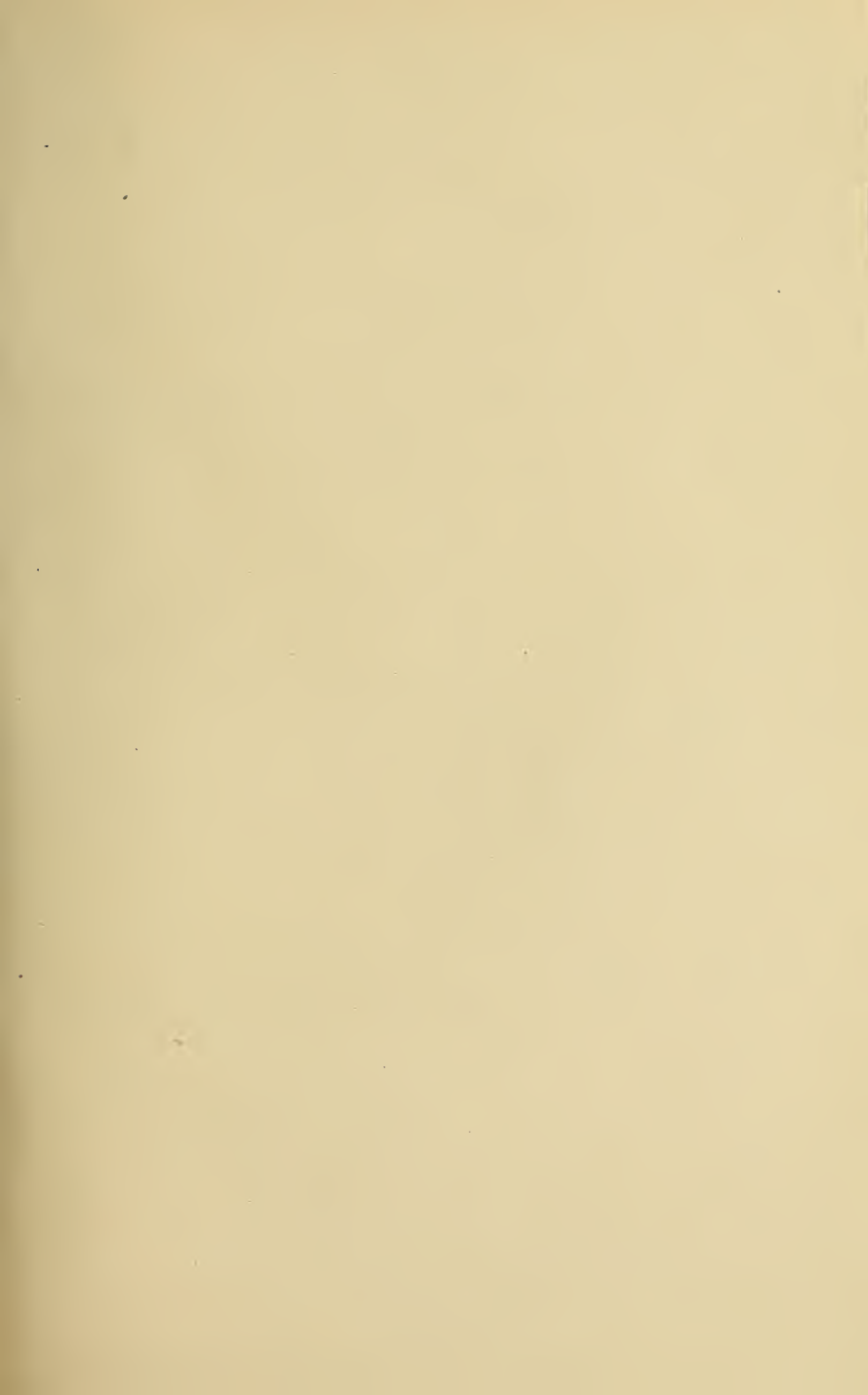
Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

[illegible]

SPACING TABLE.

Distance Between End Rivets, Number of Rivets and Spacing in Inches and in Diameters.

Number of rivets, including the end rivets.			Distance between end rivets (inches).								Diameter of rivet (inches)	
			20	30	40	50	60	70	80	90		100
18	Spacing of rivets.	Ins.	1 $\frac{5}{32}$	1 $\frac{1}{4}$	2 $\frac{11}{32}$	2 $\frac{15}{16}$	3 $\frac{17}{32}$	4 $\frac{1}{8}$	4 $\frac{23}{32}$	5 $\frac{9}{32}$	5 $\frac{7}{8}$	
		Diameters.	2.3	3.5	4.7	5.9	7.1	8.3	.....	.....	.....	1/2
			1.9	2.8	3.8	4.7	5.7	6.6	7.6	8.5	.....	5/8
			1.5	2.3	3.1	3.9	4.7	5.5	6.3	7.0	7.8	3/4
			1.3	2.0	2.7	3.4	4.0	4.7	5.4	6.0	6.7	7/8
			1.2	1.8	2.3	2.9	3.5	4.1	4.7	5.3	5.9	1
			1.0	1.6	2.1	2.6	3.1	3.7	4.2	4.7	5.2	1-1/8
19	Spacing of rivets.	Ins.	1 $\frac{1}{8}$	1 $\frac{21}{32}$	2 $\frac{7}{32}$	2 $\frac{25}{32}$	3 $\frac{11}{32}$	3 $\frac{7}{8}$	4 $\frac{7}{16}$	5	5 $\frac{9}{16}$	
		Diameters.	2.2	3.3	4.4	5.5	6.7	7.7	8.9	.....	.....	1/2
			1.8	2.7	3.6	4.5	5.4	6.2	7.1	8.0	8.9	5/8
			1.5	2.2	3.0	3.7	4.5	5.2	5.9	6.7	7.4	3/4
			1.3	1.9	2.5	3.2	3.8	4.4	5.1	5.7	6.4	7/8
			1.1	1.7	2.2	2.8	3.3	3.9	4.4	5.0	5.6	1
			1.0	1.5	2.0	2.5	3.0	3.4	3.9	4.4	4.9	1-1/8
20	Spacing of rivets.	Ins.	1 $\frac{1}{16}$	1 $\frac{19}{32}$	2 $\frac{3}{32}$	2 $\frac{5}{8}$	3 $\frac{5}{32}$	3 $\frac{11}{16}$	4 $\frac{7}{32}$	4 $\frac{3}{4}$	5 $\frac{1}{4}$	
		Diameters.	2.1	3.2	4.2	5.2	6.3	7.4	8.4	.....	.....	1/2
			1.7	2.6	3.4	4.2	5.1	5.9	6.8	7.6	8.4	5/8
			1.4	2.1	2.8	3.5	4.2	4.9	5.6	6.3	7.0	3/4
			1.2	1.8	2.4	3.0	3.6	4.2	4.8	5.4	6.0	7/8
			1.1	1.6	2.1	2.6	3.2	3.7	4.2	4.8	5.3	1
			.9	1.4	1.9	2.3	2.8	3.3	3.8	4.2	4.7	1-1/8





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